Permeable Space–a language of virtual perception

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Abstract

Can human intelligence be augmented through virtual technology? Intelligence usually refers to acts exercised in the symbolic domain – abstraction, theorization, goal-definition, problem-solving. But in addition to this domain there is a second, that of perceptual intelligence, whose extent and power can be illustrated where it is absent: restorations of vision to the blind demonstrate the impoverishment of vision when inadequately buttressed by the cognitive artifacts of a visual language. Similarly, the mechanical extension of our senses, from the telescope to tomography and most recently in scientific visualization, involve the acquisition of new languages of perception: yet the acquisition of such languages has barely been investigated. Virtual technology, with its perfectly controlled flow of information to and from the subject, is an ideal domain for the investigation of perceptual language acquisition: but further, there is no reason to pattern the invention of languages of virtual perception after the criteria of "natural" perception. The cybernetic sensory environment, theoretically, should allow the invention of sensory languages quite unlike anything obtainable in the natural environment.

"Permeable space" proposes an answer to this challenge. At issue is the possibility of constructing systems that enable the perception of hitherto unimaginable complexity by transmitting, as it were, the requisite perceptual armament. Thus, virtual technologies should somehow preside over the perceptual processes themselves, extending perception into the computer-generated world—a process called "permeation"—that results in the suspension of subject/object distinctions. Permeation opposes itself to the concept of an undisciplined perceptual "vernacular": it negotiates not what but how subjects are to see, hear, or know at the interstices of the senses. The effect is a mutual penetration of mind and machine projected in the joint cybernetic sensory environment.

1 Introduction

Can human intelligence be augmented through virtual technology? Intelligence usually refers to acts exercised in the symbolic domain – abstraction, theorization, goal-definition, problem-solving. At the same time this emphasis overlooks a second domain, that of *perceptual* intelligence, whose accomplishments are, however, at least equal and certainly complementary to symbolic intelligence. The restoration of sight to the blind, most recently described by Oliver Sacks, gives us an impression of what seeing is like when inadequately buttressed by the cognitive artifact of a visual "language." Motion and color are sensed; large objects are seen, but not recognized; yet the experience of seeing is alien, incoherent, indecipherable, unreal. Steps are seen as "a confusion, a flat surface,

of parallel and crisscrossing lines"; shadows are conceptually puzzling. The sensations of vision are like the sounds of a foreign language.

Sacks has commented on perceptual "language" and its acquisition:

> When we open our eyes each morning, it is upon a world we have spent a lifetime *learning* to see. We are not given the world: we make our world through incessant experience, categorization, memory, reconnection.

We have *learned* to see: can we learn again, in, perhaps, an idiom quite alien to that of our native perceptual language, the result of a lifetime's work? The prospects would not seem to be encouraging: Sacks' subject was, ultimately, unable to fully acquire visual "language." Nevertheless language-like learning must occur in some measure whenever unfamiliar perceptions must be made to cohere, to be experienced as wholes. The microscopist learns to see microbes, the radiologist X-rays, the astronomer galaxies. The arts may deliberately push against presumed boundaries of possible learning: an unfamiliar musical idiom may never cohere, an abstract painting may seem forever disjointed. If they do cohere, it is because the listener, or viewer, has discovered a way to renew his hearing, to hear anew. Are there natural limits to what we may learn to perceive, and if so, how are these limits to be expressed? Is our native idiom not to be undone and supplanted by an alternative perceptual vocabulary, even an alternative perceptual grammar?

Virtual Reality has, on the whole, taken a relatively conservative stance in regards the limits to perceptual learning and the inviolability of the native perceptual language, which, to the benefit of immediate (and potentially universal) access, is fully incorporated into the virtual domain, . This is in part dictated by the economic principle of present research, according to which the success of Virtual Reality depends on ease of use. There is, however, no reason why research must be restricted to this principle; the possibilities of alternative models of perceptual engagement seem too limitless, too *unknown*, to ignore, the potential benefits inestimable. At issue would seem to be entirely new ways of *knowing.*

This paper argues that new perceptual languages must, and can, be produced for virtual environments, with their perfectly controlled flow of information to and from the subject. The invention of such virtual languages need not be patterned of after the criteria of "natural" perception. One such language, called "permeable space," is described as a model of the sort of research envisaged by this project.

2 Perceptual Plasticity

In contrast with VR's perceptual conservatism, we have ample evidence that perception is relatively plastic, capable of undergoing dramatic changes in processing. This plasticity suggests in turn a quite different approach to virtual technology, one which might actively *modify* the process of perception itself. We consider the evidence.

2.1 Autogenous distortions

Sensory deprivation provides the most direct means of demonstrating perceptual plasticity. There are two kinds of sensory deprivation – the elimination of all sensory input, and the elimination of the possibility of detecting changes in the sensory environment, through continuous and meaningless stimuli – "sensory invariance." The effects, to be sure, are not immediate. Within a few days, however, organized thinking is impaired; the subject may experience hallucinations, pseudohallucinations, and occasionally auditory and tactile misperceptions. Patterned images, often described as wallpaper or stroboscopic designs, may be seen; music or the sounds of machinery may be heard. In

exceptional cases the subject may experience a rupture of the ego-boundary; some subjects have reported "floating" around the room, viewing their bodies sprawled on the bed. We assume this impression to have been the result of some cognitive artifact, a an outwardly projected distortion of body imagery, rather than a proof of the supernatural.

2.2 Exogenous distortions

The hallucinogens may also be mentioned in this context. Cohen has suggested that the effects of sensory deprivation sometimes parallel those which occur under LSD; he notes, however, that the symptoms under LSD are generally more intense. Of the many possible effects of this drug two are worth mentioning here. The first is the suspension of distinctions of subject and object; the functional boundary between the subject and his environment ceases to be operative. The second is what might be termed the "demodularization" of the perceptual subsystems—in particular, that of vision. How one sees might be directly affected by mood: "Euphoric subjects describe colors as bright and gay; should they become depressed the colors darken or are bleached out." One sees *in toto*, as a quality of the whole man. It has been described as "visual thinking."

2.3 Heterogeneous distortions

To this category belong the arts and, more especially, the perceptual experience of certain artists. The Russian formalist critic Shklovskii observed that in the course of day-to-day existence, perception is more or less automatic; the function of art, to his mind, was to render the processes of perception themselves available in an operation he called "defamiliarization," whose effect would be to make objects appear as though seen for the very first time. This suggests an ability in the artist to "undo" the effect of perceptual constancies – suspending the cognitive interpretation of, for instance, the two dimensional spread of color received by the retina. F. Barron stressed that the "creative person manages to fracture the perceptual constancies and the 'averaging' function of his mind." (Cohen, p. 80) This suspension would seem to be that of what is called "secondary process" in psychoanalysis—the socially-organized, interpretative, "averaging," and above all *reducing* mind. There can be no doubt that normative determinations of perception belong to the secondary process; psychotic disturbances can produce perceptual derangements of the kind just described.

3 Sensory Adaptation

Sensory deprivation, of these examples, is the closest in kind to virtual technology. The subject is in a contained environment, deliberately sealed off from extraneous input; signals to the subject are constrained by the controlled sensory environment. Containment illustrates the principles, and potential power, of *sensory immersion.* To be sure, the experiential framework is at complete variance with the principle of ease of use. But this need not mitigate interest in these environments. On the contrary, the extended time frame points to a lacuna in VR research.

The systematic distortion of sensory input goes back to Helmholtz, who displaced visual images with prisms. Later Stratton studied the effects of wearing inversional goggles for prolonged periods; Ivo Kohler pursued these studies with goggles that produced a variety of distortions, including up-down reversal, right-left reversal, shearing of the array at mid-line, etc. The goggles were worn for up to three months. The results are conclusive. Subjects can fully adapt to the distorted image; in time objects are *seen correctly.* A subject wearing up-down reversal goggles will eventually see the world in its proper orientation.

The key to adaptation is twofold. One the one hand, adequate *temporal scale* must be ensured. On the other, Held has demonstrated that *passive* subjects cannot adapt; active movement in the environment is positively indicated. VR ensures the latter; the former, temporal scale has not been studied, to the neglect of the entire temporal dimension of human experience.

We should note, nevertheless, that adaptation to distoring goggles does not prove the possibility of second language acquisition. J. J. Gibson observed that distoring goggles still carry information about the environment, if in altered form; biased, but not destroyed. The present issue is whether adaptation could occur in a completely altered *environment*, a "second world": what, for that matter, would constitute an adaptable second world? We know that startling *disorganizations* of perception are possible in these circumstances; the question is what sort of *re-organizations* of perception are possible? More to the point, in what way would any such re-organization differ from the native perceptual idiom? And *how* would these re-organizations be facilitated?

4 Permeable Space

"Permeable space" is a conceptual effort to clarify these questions. I would like to emphasize that there are no necessary *technological* barriers to its realization; this is not to say that it is easily realized. Here is its definition:

> **World 2b (permeable space)** suspends discontinuities between the subject and the world, at the limit of which the subject is identical to the world. Yet the world is not a mere replication of the subject. World 2b extends perception into itself–the world perceives as an extension of the subject, through the medium of what may be termed *stimulus intelligences*–stimuli actively *participating* in the process of perception. The effect is of a joint cybernetic mind; the machine environment and human perceiver have fused into a single cybernetic perceptual unit.

Ordinarily we sense ourselves to be distinct from objects in our environments. I know that I am not the tree outside my window. In permeable space I am that tree, or any object within my field of view; in fact my field of view can be multiplied to potentially any number of disparate perspectives on my environment. I know the environment in the way I know myself, apperceptively; I have become the environment. Distinctions of subject and object have been rendered inoperative: no distinctions are afforded between perception and underlying reality.

Can Permeable space be realized? This model should not be completely unfamiliar. The concentrated musician performs music more or less in this manner, and the ardent film-goer often identifies the events depicted on the screen more or less as though he were the subject. The parallels are extensive. Even the multiplication of distinct perspectives can be effectively rendered through the common cinematic language.

The idea of a "joint cybernetic perceptual unit" is certainly without any immediate correlates in common experience, and is therefore more difficult to imagine. Ordinarily, a perceiving subject would seem to be uniquely in charge of the *process* of perception, as dictated by his perceptual language. To be sure, this language is rarely deployed (or, pursuing the analogy, "spoken") at the conscious level; the "visual thinking" of hallucinogens and the "perceptual fragmentations" of creative minds count as notable exceptions.

Now, just as some film viewers allow themselves to be suggestively eased into an identification with the events on the screen, the co-cybernetic subject allows certain perceptual *processes* to come under machine control. That is, the manner in which data is perceptually organized is somehow co-determined, mediated by the machine environment.

Permeation is the effect of this suspension of autonomous perceptual function; at the same time, it may be suggested that this suspension may also be the effect of permeation. When the perceptual facts of an individual are altered, his identity may come into question; at the same time, a change in identity–the result, say, of a dramatic change in mood–may alter the facts of perception. It is not clear to what extent individuals are independent of their perceptions; Merleau-Ponty has argued that there is in fact no distinction. We are not what but *how* we perceive.

It seems probable that this unfamiliar relinquishing of familiar control will be resisted by the defenses of the ego, those which strive for relative autonomy or perceptual impermeability. In part, this is why extended immersion is indicated for a space of this description.

It is exceptionally difficult to think beyond the suspension of autonomous perceptual function. One can imagine that, somehow, those processes mediated by the virtual space could appear as objects in the environment; the permeated subject would perceive these objects as himself, actively perceiving. These projections of the perceiving self could become independent agents of extended perception, messengers pursuing independent search strategies on the model of perception they incorporate. They would be knowable not as symbols but as something more direct, a way of sensing. But these speculations can lead nowhere until the hypothesis they subtend is resolved; namely, that functional permeability is possible. To this problem we now turn.

5 Towards Permeation: basic consideration

The characteristic of permeability is the failure to distinguish between subjective and objective phenomena, to decide whether a sensation comes from within or without. Balint has suggested this to be the central problem of reality testing in schizophrenics, a confusion of the kind dramatized by Poe in the "Tell-Tale Heart". In fact, permeation occurs naturally through all the senses, as William James suggests in the following anecdote, illustrating the so-called "proof-reader's illusion"':

> I remember one night in Boston, whilst waiting for a 'Mount Auburn' car to bring me to Cambridge, reading most distinctly that name upon the signboard of the car on which (as I afterwards learned) 'North Avenue' was painted. The illusion was so vivid that I could hardly believe my eyes had deceived me. All reading is more or less performed in this way. (*Principles of Psychology*, II/96)

We are, of course, permeated by language; what we *think* we are reading may be not at all what there is to be read. Perception is fused with expectation. What James indicates with the remark "All reading is more or less performed in this way" is that the perceptual correlates of reading are actively *projected* into the environment, and perceived as though these correlates *were* in the environment. James' astonishment reflects on the degree of inattention to which this process is ordinarily given.

James' error was, fortunately for him, self-correcting. The projection of non-reality-corroborating information into the environment can, in pathological cases, be much less self-correcting. The schizophrenic may project voices "in his head," to which he attributes independent existence; the fact that they originate from within the head is not taken as a sign that these are his own voices, since he can exercise no control over them. We might say that the schizophrenic is permeated by his imagined voices.

Hearing and speaking, whose distinctions the schizophrenic in some sense does not uphold, are natural complements of one another. Vocalization is the perhaps the most eloquent projective resource fed back to its corresponding perceptual mode. The Brahmans saw in this an archeological remnant of the avatars of mankind, a vestige of man's divine descent. These avatars were mythologized to be light-giving as well, establishing

in them an exteriorizing complement to vision. Vocalization/hearing is in some ways reminiscent of the bat's primary perceptual modality, echolocation.

Echolocating bats cast auditory shadows on objects in their environments. The shadow is, perhaps, perceived as an alteration in self-perception; the environment is a quality of the way the bat perceives its own vocal emissions.

An apparatus could be devised which transmitted signals to an anesthetized bat which produced the cumulative effect of signal and echo, as perceived by the bat. Would the bat perceive this signal as itself perceiving, as something else perceiving? If so, permeation would have been achieved; mechanical extensions of this transmitted perceptual apparatus would then be thinkable.

6 Cybersemiotic realization of Permeable space

I now conclude with a rough sketch showing how some of these ideas might be implemented. This sketch is not meant to be conclusive. It is merely hoped to serve as an impetus to further research.

Permeable space can, I believe, be realized by an implementation of the following principle: *perceptual changes are projected into the environment; that is, a change in perceptual processing implies a change in the environment.*

Human information-processing is, as the James example implies, a process that actively *seeks* information. More recently Edelman has stressed this point. As an instance of information-seeking, consider the phenomenon of the habituation of the orienting response. The tendency of repetitive stimuli to produce *lowered* arousal—as measured, for instance, by galvanic skin response—has been well documented. Typically, researchers have shown that an initial presentation of a stimulus causes maximal arousal—the so-called orienting response. During subsequent presentations, arousal declines, as the organism habituates to predictable arousal. E. N. Sokolov has proposed that the brain constructs a predictive, or *neuronal* model of events in the environment, against which incoming stimuli are matched. The production of this neuronal model can be construed to play a vital role in perceptual processing; we know that we are perceptually attuned to novelty; indeed, we lack the resources to perceive unchanging stimuli for more than brief intervals.

Now, what if a stimulus-generating unit were able to *model* the neuronal model with reasonable accuracy? Any well-crafted piece of music does this, in some degree; were that degree to be escalated through the development of an appropriate computational resource, perceptual processing, in the sense just outlined, might be placed under external control. Habituation could promote a compensatory change in the stimulus; changes in perception would be directly projected into the object of perception itself, realizing "stimulus intelligence." It may be inferred, though massive experimentation will be needed to bear this out, that adaptation to an environment of this description would have the effect of *exteriorizing the subject*: some degree of permeation will have been achieved. Analogizing from Kristeva's notion of "semiosis," a process whereby subjects are constituted in their defenses to incoming stimuli, this procedure may be termed "cybersemiosis."

Two obstacles prevent the realization of a cybersemiotic environment. The first is that fully operative computational resource along the lines indicated is lacking, although initial efforts have been made. The second, perhaps graver yet, is the problem, intrinsic to the realization of Permeable space, of adumbrating perceptual responses in the subject.

A solution might be found in the use of an artificially *projective* information-processing modality, as suggested above. Call this "virtual echolocation"–a means of sensing by *active* inspection of the sensory environment, as through touch. "Echolocation"—however refined through some virtual composite of our sensory resources–may be the ideal mode

in which to investigate the possibilities of permeability, including the artificial permeation of a subject through machine-mediated language. Analogizing with the James' example, information put into the sensory environment is readily available to a machine interpreter. Perception is effected through kinetic action, which, therefore, is available to the virtual environment.

7 Summary and Conclusions

Summarizing, we have ample evidence that disorganizations of perceptual processes may be effected by various means, both sensory and chemical; re-organizations of a simple kind are possible. Regarding sensory-induced re-organization, an expansive time-scale may be required for adaptation; research in virtual technologies should consider an increase in this scale, if only as a way of determining inviolable constraints in native perceptual languages, ensuring greater flexibility in the architecture of virtual worlds. Permeable space, a virtual environment whose object is to induce the suspension of subject/object distinctions, is presented as a model environment which violates standard perceptual discriminations; its inferred effect would be to project the subject into the environment itself, in a manner reminiscent of certain interesting effects of sensory deprivation. Permeable space may have especially interesting applications in the area of scientific visualization, not to speak of an electronic metaphysics; but much experimentation will be needed to bear out these ideas.

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