Proceedings

*IEEE 1993 Symposium on Research Frontiers in Virtual Reality*

October 25-26, 1993 San Jose, California

# Understanding Synthetic Experience Must Begin with the Analysis of Ordinary Perceptual Experience

## Position Statement

Jack M. Loomis
Department of Psychology
University of California, Santa Barbara CA 93106

### Abstract

*The emergence of teleoperation and virtual environments has greatly increased interest in "synthetic experience", a mode of experience made possible by both these newer technologies and earlier ones, such as telecommunication and sensory prosthetics. I maintain that understanding synthetic experience must begin by recognizing the fallacy of naive realism and with the recognition that the phenomenology of synthetic experience is continuous with that of ordinary experience. I demonstrate the continuity of synthetic experience and normal perceptual experience with respect to two issues: the determination of a person's phenomenal location in space and the experience of "being in touch with" near and remote objects.*

The emergence of teleoperation and virtual environments has greatly increased interest in "synthetic experience" [1], those forms of experience which are made possible both by these newer technologies and by earlier ones, such as telecommunication and sensory prosthetics. Recently, a number of authors have offered a variety of taxonomies and conceptual schemes for thinking about the experiential states associated with synthetic experience (e.g., presence, externalization) and the properties of the effector/display arrangement that promote various degrees of perceptual realism [1, 2-9]. Here I assert that an understanding of synthetic experience must begin by acknowledging that the phenomenology of synthetic experience is continuous with that of ordinary experience.

In previous articles [6, 7], I have argued that in seeking to understand the phenomenology associated with the use of teleoperators and virtual environments, we must recognize the fallacy of naive realism, the unreflective view that the world we experience around us is one and the same as the "physical world." Vision, for example, is experienced as a transaction between observer and environment in which the eyes are mere windows on the physical world. This view fails to recognize that ordinary experience is mediate--that what we experience is an elaborate construction of our senses and nervous system that is so highly functional a representation of the surrounding environment that we unsuspectingly act upon the former as if it were the latter. In its place, we need to substitute a form of representative realism that makes the distinction between the phenomenal world, that of which we are directly aware, and the physical world, that which underlies our phenomenal awareness but can only be known through inference. Among the facts that demand this alternate view is the trichromacy of human color vision--while color is part of the very fabric of the visual world, its strict three-dimensionality is a consequence neither of object pigmentation nor of light but of processing within the visual system itself.

An important division within the phenomenal world is that between "self" and "non-self". Normally, but not always, stimulation arising from outside of the observer's physical body is attributed to the non-self. However, there are varying degrees of this distal attribution or externalization. At one extreme the observer is aware of the immediate visible, audible, and palpable environment of ordinary perception; at the other extreme, the observer experiences "being in contact with" remote objects and events (e.g., through telephony and television).

Users of virtual and teleoperator display systems can experience either "being in" the remote or simulated environment (presence) or "being in contact with" the remote or simulated environment (distal attribution, telepresence). Presence occurs when the observer has neither prior knowledge nor sensory information signifying that he/she is using a virtual or teleoperator display; the experience then ought to be that of being in the location of the slave device (in the case of a teleoperator) or in the location specified by the virtual environment system. More commonly, however, the observer will also have some sensory information or prior knowledge that he/she is interfaced to a display; in this case, the experience probably will be one of being in one location but "in touch with" a remote or simulated environment.

It is not surprising that many of the articles cited above avoid any explicit consideration of the phenomenology of normal perception, for the authors may have been reluctant to broach the topic of

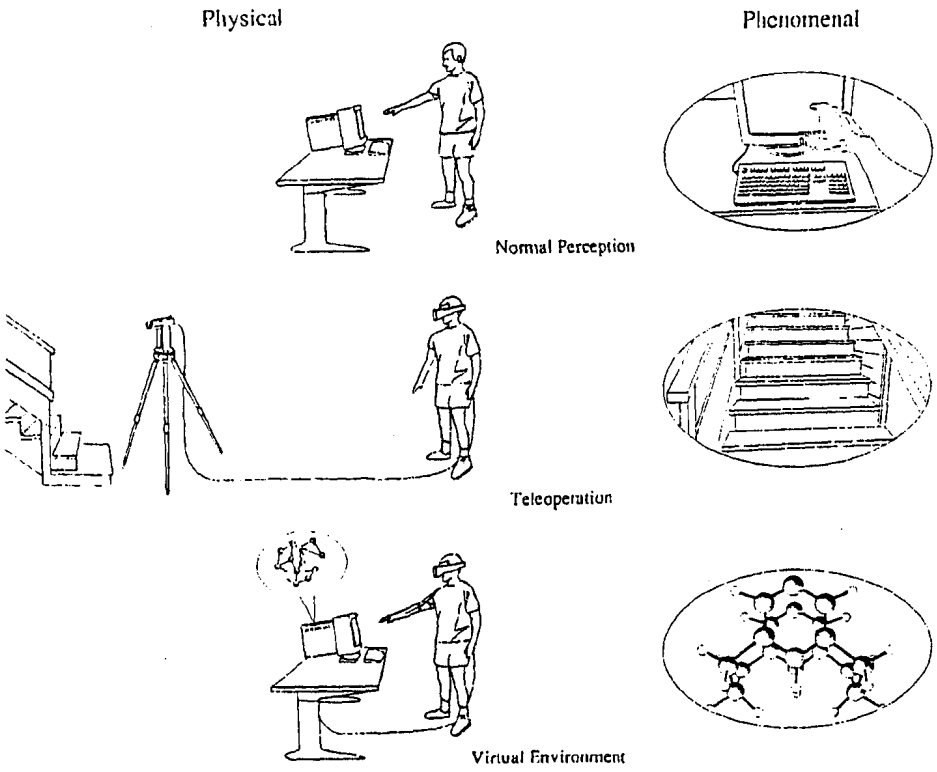
phenomenology out of a concern that a discussion of phenomenological ideas will inevitably lead to a muddle. Although I share the same reservation, I believe that an understanding of "synthetic experience" can come about only by confronting the very real philosophical issues [e.g., see 11-22].

In this brief article, I attempt to show the continuity of synthetic experience and normal perceptual experience with respect to two issues: the determination of a person's phenomenal location in space and the experience of "being in touch" with near and remote objects.

In examining the question of what determines a person's phenomenal location, we begin by recognizing that localization is always relative to some environment; the issue is not one of knowing one's coordinates in some absolute coordinate frame. Furthermore, the discussion will focus on sensorily-based localization and not upon the contributions of memory and thought, which alone determined the localization of the Dennett's hapless ego when all sensory input was lost (in the insightful and provocative essay, "Where am I", by Dennett [10]).

It is clear that one can experience being at a determinate location only to the extent that the sensory field is spatially differentiated. If the sensory field is uniform, then one's self-localization is indeterminate. If the sensory field varies only slightly, then one can only localize oneself approximately. For example, if all one has is the sense of smell and a spatial gradient of some odorous substance emanating from a source, then one at best can tell one's direction relative to the source. We can surely conclude that the spatial uncertainty with which one self-localizes is determined by variations in the sensory field and one's perceptual sensitivity to these variations; this is true for both direction and distance. If a person is asked to state as precisely as possible where he/she is located within space, vision is likely to be the most important determinant of the "egocenter". Because the spatial structure of light and the visual system together provide the most spatially articulated field of all the senses, localization by sight is the most determinate. The acoustic environment and auditory system provide a well articulated sensory field as well, but one that falls far short of that provided by vision.

Where then is the visual "egocenter"? This is a question that has been the focus not just of speculation but of empirical research as well (e.g., 23-24). One method for determining the egocenter is to find the approximate physical intersection of the extensions of rods at different locations in space that have been adjusted by the observer to appear to point directly to the observer. The physical location of the "direct egocenter" given by this method, however, depends upon how the observer views the rods. If the observer views with just a single eye while keeping the head stationary, the visual egocenter coincides with the center of the rotation of that eye [23]. If instead, the observer views with both eyes, the direct egocenter shifts to a new location that is usually somewhere between the two eyes. In either case, the direct egocenter identifies the origin of phenomenal visual space with a rather precise location in physical space (see figure.) Interestingly, the observer judges the



apparent (or judged) egocenter to be the same in the two cases [23]. That the observer experiences the egocenter as somewhere within the phenomenal head presumably results from the observers' being able to see portions of the physical head within the larger visual field.

If the only sensory information that an observer has for self-localization is an articulated visual field provided by a teleoperator or virtual display, then lacking prior knowledge to the contrary, the observer clearly ought to localize himself/herself relative to the objects within the remote or simulated visible environment (see figure.) In actuality, of course, this ideal is probably unattainable. Instead, the observer will have sensory information or prior knowledge indicating location of the observer's physical head. The likely result is that the observer will experience being in one location but in contact with the remote or simulated environment (distal attribution or telepresence).

I now turn to the experience of "being in contact with" objects and environments that vary in their degree of physical remoteness. I begin with haptic touch [12-14, 25-26], where the observer typically explores the surroundings with arms, hands, and fingers. When we touch a hard object with the bare hand, we invariably experience this as direct contact with the object. Now if, instead, we wear gloves or feel the object when it is covered with layers of fabric, the sense of feeling the object itself is often nearly as compelling [14] even though the contact between skin and object is now less physically direct. An even more indirect form of touching is exploring an object with a hand-held probe [13, 14, 16, 18, 27]. Observers describe the experience as contact between the probe and object rather than as vibrations or deformations of the skin. Still even more indirect is the haptically-mediated use of the Tactile Vision Substitution System [28-29, 21-22], a system that consisted of a television camera driving a matrix of vibrating stimulators placed against an observer's back or abdomen. By actively manipulating the camera, observers were able to scan a high contrast object, the images of which were converted to vibrotactile patterns. Although, initially, observers reported experiencing only changing patterns of vibration on the torso, extensive practice led some of them to report experiencing stationary objects in front of them.

The fact that we tend to attach greater import to distal attribution when feeling with a probe than when feeling directly with the hand is to be explained by the difficulty we have in expunging naive realism from our thinking. In fact, direct touching between bare skin and object is no less a constructive process than is indirect touching. The same can be said for vision and audition; whether or not these senses are "extended" by optical, acoustic, or electronic devices, the resulting perceptions are always mediate, never direct, for the central nervous system constructs what is perceived. Thus, whether the senses are "extended" or not, the experience of "being in touch with" some object or environment that is within arm's reach, miles away, or just a computer simulation is a phenomenological consequence of the same perceptual process. This experience of distal attribution depends upon the observer being able to form an internal model of the linkage between the efferent commands from the brain to the muscles and effectors and the consequent changes in afferent information ascending the sensory pathways [4, 6, 21, 22, 30, 31]. A very simple linkage is that involving movement of one's one arm; efferent commands to move the arm produce a tightly coupled change in visual stimulation as the visible arm moves. A much more complex linkage might be movement of a pair of video cameras mounted on a remotely located robot being controlled by the operator. If the observer can model the linkage that controls the robot, he/she will experience either being at the remote site (presence) or being in contact with it (distal attribution). If, however, the linkage, even though determinate, is too complex to be learned by the operator, distal attribution or presence will not ensue.

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