Controller Mediation in Human-Computer Play

An Honors Thesis for the Symbolic Systems / Human Computer Interaction Program

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I. Introduction

Boy 1: "You mean you have to use your hands?"
Boy 2: "That's like a baby's *toy!"*
—Arcade kids to Marty McFly, Back to the Future Part II

In the mid-to-late-20th century, the advent of the computer game signaled the beginning of a new mode of play interaction. Whereas previously playing a game would typically involve direct physical interaction with its elements (soccer balls, billiards, chess pieces), computer games introduced the notion of using hardware input devices to produce game action, with the consequence that any arbitrary quantifiable physical input might be transduced to produce any arbitrary game output. Computer input devices are therefore novel intermediaries in games and the act of play, and the psychological and qualitative impacts of their design and usage on players, as well as their symbolic role in an increasingly mediated society, are the topics of this paper.

I.A The Nature of Play

Obviously, the introduction of computer technology into the domain of play and leisure greatly expands its range and potential; however, before we identify these new possibilities, it will be necessary to determine, to some extent, what exactly I mean by "play". Academically, play has always been a contested and nebulous term possessing many postulated qualities, none of which have proven to be necessary or sufficient to define it. Play anthropologist Gordon Burghardt enumerates the qualities that people traditionally associate with play acts:

> …no obvious immediate function, pleasurable effect; sequentially variable; stimulation-seeking; quick and energetically expensive behaviour; exaggerated, incomplete, or awkward movement; most prevalent in juveniles; special 'play' signals; a breakdown in role relationships; mixing of behaviour patterns from several contexts; relative absence of threat or submission; and the relative absence of final consummatory acts (e.g. biting, intentional injury or killing, eating, copulation). (6)

One can readily see how many of these traits apply to contemporary human-computer play: in the realm of home video gaming, for instance, games are obviously designed to produce a "pleasurable effect"; roleplaying games like *Everquest* are clearly given to "breakdown in real-life role relationships"; many might argue that games serve "no obvious immediate function"; and so on.

A still broader conception, originally formulated by M. Bekoff and J.A. Byers, describes play as "all motor activity performed postnatally that appears to be purposeless, in which motor patterns from other contexts may often be used in modified forms and altered temporal sequencing" (qtd. in Martin 73). And yet another claims that "Most definitions of play, diverse as they are, agree that one prerequisite of play is that it is an intrinsically motivated activity" (Simon and Smith 205).

There are still other designations that account for play in terms of its goals, rather than its surface characteristics. Some evolutionary perspectives identify play as a means of skill training, cognitive development, and physical conditioning (Burghardt 12), or alternatively, as a vestigial trait of those with greater physical capacities (Burghardt 13). Brian Sutton-Smith identifies several social and cultural activities as forms of play, including mental play (daydreaming, reverie, etc.), informal gathering, attending performances, performance, celebration and festival, contest, and risk-taking (*Ambiguity* 4-5). Furthermore, he claims that meaning is communicated through play, such that it may serve purposes of education (84), aggression (88), conflict resolution (80), ego mastery (54); creative expression (128), and identity formation (111). On a more metaphysical level, Sutton-Smith quotes physicists such as Schrodinger, Eigen, and Heisenberg, each of whom claim to some extent that, due to its inherent lack of rules and necessity, play is a basic component of what makes people human—that it is "play and only play that makes man complete" (qtd. in *Ambiguity* 59).

It is easy for most people to consider examples of play that are consistent with one or more of the above traits or guidelines, and indeed, play is a concept that is grasped intuitively upon observation; play researcher Paul Martin asserts that even when observing the behavior of other species, people usually "find play easy to recognize" (Martin 73). However, there has yet to be formulated a play archetype as such; and it has not been established that any activities lacking some (or all) of the above traits may be excluded from the definition of play. Part of this definitional problem concerns the seemingly contradictory goals of different types of play. In "The Idealization of Play", Diana Kelly-Byrne and Brian Sutton-Smith enumerate forms of play that undermine several of Burghardt's claims: threat and submission, for example, is an active part of many forms of modern playground games. One's unwillingness to participate in a painful, cruel, or even sexually degrading game may lead to social ostracization (312); moreover, the games themselves (e.g. "Tug o' War", wherein a child believes he is playing blindfolded tug-o-war, but is instead urinated on by other children) may involve humiliation or injury of the participants (ibid.).

The many apparent contradictions between different forms of play necessitate a certain informal convention in academic treatments of play: one must either select a specific, rigid aggregate of qualities at the outset, which they choose to define as "play" for the duration of the paper; or, as Brian Sutton-Smith has advocated in *The Ambiguity* *of Play*, one ought to tolerate the paradoxes that both popular and academic conceptions of play inevitably introduce, since the form, purpose, and subjective enjoyment of different play activities is as varied as the human players themselves. In the conclusion of that book, Sutton-Smith enumerates his presuppositions in his discussion of play:

> 1. that play's definition must be broad rather than narrow, including passive or vicarious forms as well as the active participant forms, including daydreams as well as sports and festivals.
> 2. that it should apply to animals as well as humans, and children as well as adults.
> 3. that it should not be defined only in terms of the restricted modern Western values that say it is nonproductive, rational, voluntary, and fun. These are not concepts that can prevail as universals, given the larger historical and anthropological evidence to the contrary.
> 4. that play is not just an attitude or an experience; it is always characterized by its own distinct performances and stylizations.
> 5. that it can be as momentary as a piece of wit, or can endure as long as the one-year cycles of festivals or the four-year cycles of the Olympics. That it can be spatially either as diffuse as a daydream or as articulate as a sports stadium.
> 6. that play is like a language: a system of communication and expression, not in itself either good or bad. ("Ambiguity" 218-219)

If we are to surmise anything about the nature of play from these notions of play, it is that it cannot and should not be reduced to a rigid set of necessary or sufficient attributes. Social play researcher Neil Chalmers argues that it is a mistake to apply general theories of play to any specific field of inquiry (Chalmers 120). Rather, he suggests that "description of play should… be for a purpose" (ibid.) and that "it is more fruitful… to tailor one's definition of play to the investigation in hand, and not attempt to construct an absolute dichotomy between behaviors that are playful and those that are not" (ibid.). Accordingly, since the topic of my thesis is not play in general but rather how technological mediation of games affects play behavior, it is more fitting to construct a definition that places the role of the computer device at the fore, while covering as broad a range of play archetypes as possible.

To this end, I will attempt to create a definition of human-computer play that maintains an all-inclusive definition of play's purposes and forms, while emphasizing how technologically mediated play is possible and qualitatively distinct from non-mediated play. The characteristics of play mentioned thus far should be used as heuristic guides as to what is meant by the term “play” in this paper, but I will disclaim here that when I use the term in this paper, it is with the understanding that actions that are in many ways very dissimilar may be legitimately referred to as “play”.

I.B Human-Computer Play and the Three Agent Model

Merely designating computer game play as “the usage of computer devices for the purposes of play” is insufficient to characterize the kind of interaction described in this paper. After all, one might use a computer to surf the web for many of the reasons and with many of the qualities of play listed above, but unless one is referring to an online gaming service, one would not typically label web-browsing as an act of “play” or as a “game”. Therefore it seems intuitively inappropriate to refer to all enjoyable interactions with a computer as video game play. On the other hand, we must devise a non-prescriptive definition that allows for models of interaction beyond those that currently exist.

In order to capture the essence of what it means to play a computer game, I will now put forth a paradigm of interaction which I will refer to as the “Three Agent model”. This model conceptualizes all video gaming acts as a rigidly defined exchange of sensory stimuli and play action between three well-defined, but not necessarily distinct conceptual entities: the *player*, the *controller/peripheral* (or for now, just *C/P*), and the *mainframe*.

The mainframe[1] is the primary non-player play entity, the "brain" of the game that is ultimately responsible for all output directed towards the player. It establishes and maintains the environment, rules, objects, settings, directives, scripted events, and properties of the virtual world, collectively referred to here as the *game state*. In the familiar contemporary video game console paradigm, it is represented by a combination of whatever physical game disk is being played and the game console itself; however, it may also consist of non-mechanical components, such as the prizes in a crane game (whose game state is described by the constituency and position of the prizes, the position of the crane, etc.). The mainframe is acted upon exclusively by the controller, and it may produce output through the peripheral. To reiterate: in the context of the Three Agent model, the *mainframe* is *the entity that establishes and upholds the game state, dictates the immutable terms of the game being played, executes actions received from the controller, and produces any appropriate output through the peripheral*.

The term "player" often refers to a human agent who is interacting indirectly with the mainframe by issuing commands via the C/P; however, we must make our definition more rigorous, forward-thinking, and inclusive. More abstract than simply a "human participant", the player is the entity that makes the decisions and executes actions that lead to progress or non-scripted change in the game state, responding to the parameters established by the mainframe. The player does not necessarily have to be human, nor does it need to be intelligent or process information in the classical "human" sense, but it does need to make its decisions independent of direct influence by the mainframe. It

[1] I use this term in lieu of "computer", as the mainframe is not always just a computerized component, but may also include the game disk, memory card, and whatever other piece of computing necessary to maintain the game state of a given game. According to the 2004 4th edition American Heritage dictionary, "mainframe" is a broader term referring to "The central processing unit of a computer exclusive of peripheral and remote devices", which is the term nearest to the entity I describe here.

issues all of its commands though the C/P, and receives all of its information about the game state from the C/P. I will thus conceptualize the *player* as *the entity that affects change in the mainframe's game state by means of direct interaction with the C/P, whose decisions are made independent of the mainframe*.

At last, we arrive at the focal subject of our discussion, the controller. As mentioned above, "C/P" is merely a convenient shorthand I am employing for the term "controller/peripheral". This term clearly refers to two distinct entities, the *controller* and the *peripheral*; both terms describe discrete computerized entities that are somehow linked to the mainframe. The "controller" refers to *all of the computerized or mechanical input devices that are acted upon by the player in order to affect change in the mainframe*. These could be video game controller devices as we know them today, or a combination of a PC keyboard and mouse, or a microphone used for voice input—as long as it translates action from the player into input for the mainframe, it can be considered a controller, and so the function of input plays a defining role. A "peripheral", on the other hand, is *any device used to transmit sensory or perceptual information from the mainframe to the player*. The visual display and auditory output employed in almost all contemporary video gaming makes the monitor (computer and television alike) and the speaker two of the most widely employed peripherals today, so common that they are tacitly assumed to be video gaming requisites—we will see later that this is not the case.

There are a few reasons that the concepts of controller and peripheral are bound together in this model of human-computer play interaction. First of all, we see that they serve conceptually reciprocal functions in the central dichotomous relationship between player and mainframe: the controller conveys information to the mainframe in order to affect the game state, and the mainframe outputs information through the peripheral, presumably in order to have some impact in the player's mental state. Another indication that the peripheral and the controller play naturally complimentary roles is the definitional overlap the two terms share in common parlance. When used to refer to a gaming device, "controller" may (though not necessarily) refer to a device with both input and output functions, such as a Nintendo GameCube controller, which has a "rumble" function. The device is typically referred to by gamers as a controller rather than a peripheral, though it performs a function—rumble output—that is unrelated to input. On the other hand, "peripheral" in computing terms has been formally defined as "an auxiliary device, such as a printer, modem, or storage system, that works in conjunction with a computer" (Heritage); this definition disregards the input/output role of the device, thereby encompassing both peripheral and controller. In these senses, then, it seems that people are comfortable with amalgamating the two terms.

This paper focuses only on the controller half of the C/P entity, for the simple reason that game input and game output are distinct topics with separate considerations[2].

One point of clarification: one might wonder why I have chosen to designate the C/P device as an "agent" in this model. Since the term "agent" is commonly held to denote something with the power or ability to act and make decisions, it seems to be misapplied to the C/P entity, which merely conveys information back and forth between the player and the mainframe without any agency of its own. I counter this intuition by pointing out two facts: first, the term "agent" can also be used to denote an entity that performs actions on the behalf of another entity; consider the examples of "literary

[2] The reasons for this are fairly obvious, but just to be clear: input deals with the ways that transduction of physical action into game action create new opportunities for game play, while output relates to technology's capacity to convey meaning and information by acting on and manipulating human sensation.

agents", "employment agencies", and the semi-autonomous "software agents", in the idiom of human-computer interaction. C/P devices certainly fit into this conception of the "agent", though admittedly it is a different sort of agent than that which describes the player or the mainframe. Second, as we will see over the course of this paper, the C/P device makes contributions of its own, independent of any actions of the player or mainframe. By its capacity to influence the player's perceptions and considerations of the game (Chapters II and III), to be appropriated and adapted in several ways (Chapter IV), and to accept input other than that of the player (Chapter V), the controller asserts itself in the dynamic of human-computer play, and is in this way an agent in the same sense as the player or the mainframe.

I.C A Classification of Modern Game Devices

What we have illustrated so far is a purely abstract, theoretical conception of the controller, a distillation of what it means to be a controller within the framework of the Three Agent model. We have thus far scrupulously avoided any mention of its physical manifestations; to make this discussion somewhat more tangible, we will now discuss some of the properties common to input devices, as well provide a few examples of popular modern controller paradigms.

Just as there exist no all-purpose computer input devices, there is no such thing as a "general" controller or peripheral; attempting to detect the physical characteristics common to all game devices is as futile as trying to describe in general what a piece of furniture looks like. However, the computer and gaming industries at large seem to have established a few informal standard models of controller design, whose influence can be easily discerned throughout the short history of video game consoles; we now turn to the most established controller paradigms, in order to illustrate a few of the popular ways that people have interacted with their computer games in the past.

The Joystick: The joystick model is one of the earlier archetypes of a dedicated gaming interface, originating with the Channel F console's controller in 1976 (Burnham 132). This archetype consists of a throttle-like directional control, either gripped by one (or possibly both) of the hands, or pushed in the appropriate direction by placing the thumb on the top of the shaft; the original controller for the Channel F console could also be rotated and plunged up and down (Burnham 132). Any number of buttons is mounted either on the stick itself or elsewhere on or near the device; these are traditionally operated with the right hand[3].

The "Atari Games Joystick". (polarize)

The Gamepad: This controller archetype consists of a handheld unit operated by the fingers and thumbs. The layout traditionally consists of directional controls manipulated by the left thumb and button input operated by the right hand, though this is not the case by necessity, as all current controllers have both button input and directional control available to both hands. The first example of what most people recognize as a gamepad came with Japan's Famicom system, later redesigned and introduced to the US market as the Nintendo

The original proprietary NES gamepad (NESPlayer.com)

[3] The joystick may rightly be considered a variant of the "paddle" controller archetype, which used a small dial instead of a stick to move onscreen objects along a single axis. The reason it was called a "paddle" was because of its strong association with the paddle objects in games like *Tennis for Two* and *Pong*.

Entertainment System. Gamepads have come standard with most home gaming console devices since the NES, and are usually required to play the majority of console games.

The Light Gun: In 1967, Ralph Baer modified a plastic toy rifle into a light-sensitive gun that could respond to signals on a television screen, thus designing the first known instance of the "light gun" (Burnham 55). This controller is defined more or less by its similarity (both in appearance and gameplay function) to real-life firearms: the player aims the light gun at onscreen objects and shoots by squeezing a trigger; additional buttons are occasionally added on the gun for added functionality. The handgun model is currently the most prevalent, but there have been devices that have adapted the sniper rifle (*Silent Scope*), the hunting rifle (*Shooting Gallery*, *Deer Hunter*), the machine gun (*LA Machine Guns*), and even a scaled-down bazooka (the *Super Scope*).

The Zapper, an early NES light gun. (DeNaca)

The Steering Wheel/Gas Pedal: Much as the light gun simulates the real-life gun, the steering wheel and gas pedal resemble and are operated in the same manner as their corresponding traditional automobile components, for games and simulations in the driving genre; the first example of this is found in Atari's *Gran Trak 10* arcade game, in 1974 (Burnham 101).

The Dance Pad: A more recent phenomenon, this model of input is thus named due to its popular usage in dancing games, with *Dance Dance Revolution* being the current popular standard. This model of gaming device did not originate with dancing games, however, as similar footpads had been designed for earlier athletics games (the Nintendo *Power Pad*).

The Mouse and/or Keyboard: This model should be immediately recognizable to those familiar with modern computing, as it simply applies the standard keyboard/mouse paradigm to the domain of game play. Though the mouse is relatively constant and confined to the realm of PC gaming, the keyboard has historically appeared in many guises[4] and bears such close relatives as the keypad and the musical keyboard. Exactly how the keyboard and mouse components are adapted to gameplay is usually unique to the game, but one standard of usage is prevalent enough to note here. The "WASD" configuration, currently a standard for most first-person PC games, possesses several variations depending on the nature of the game being played, but primarily involves using the keys W, A, S, and D to represent, respectively, the forward, back, left, and right directional keys, which are operated by the left hand. The mouse is operated by the right hand, with the mouse buttons typically serving whatever primary action functions the game demands, and the numeral keys and mouse keys are generally employed for switching between weapons, where appropriate.

An arcade-style *Dance Dance Revolution* dance pad. (buynshop.com)

A standard WASD configuration, with the red keys indicating movement. (Danbury)

[4] The "Qwerty" configuration is the current standard, though notable historical alternatives include the Universal Keyboard, the Sholes configuration, "Dvorak", and the alphabetical configurations (Tenner 200-1).

Though the controller models listed above constitute the vast majority of input devices employed now and throughout the history of computer gaming, they by no means necessarily represent the full range of possibilities for the game device, nor are they necessarily representative of the full breadth of game device paradigms currently available. First, there is a recent trend of hybridization, in which features from one controller archetype migrate to others; for instance, console controllers of the current generation feature the analog stick, a directional control resembling a small joystick shaft operated with the thumb. Lesser known devices take as their input not only mechanical pressure, but movement, light, sound, orientation, global position, and, as an example of boundless whimsy in controller design, streams of urine (Maynes-Aminzade and Raffle). Vannevar Bush, one of the original researchers and theorists of information technology and computer interfaces, describes still more distant possibilities of interfaces in the future:

> The impulses which flow in the arm nerves of a typist convey to her fingers the translated information which reaches her eye or ear, in order that the fingers may be caused to strike the proper keys. Might not these currents be intercepted, either in the original form in which information is conveyed to the brain, or in the marvelously metamorphosed form in which they then proceed to the hand?
>
> By bone conduction we already introduce sounds into the nerve channels of the deaf in order that they may hear. Is it not possible that we may learn to introduce them without the present cumbersomeness of first transforming electrical vibrations to mechanical ones, which the human mechanism promptly transforms back to the electrical form? With a couple of electrodes on the skull the encephalograph now produces pen-and-ink traces which bear some relation to the electrical phenomena going on in the brain itself. True, the record is unintelligible, except as it points out certain gross misfunctioning of the cerebral mechanism; but who would now place bounds on where such a thing may lead? (Bush 107)

These devices, among others, will be discussed in the later in this paper.

I.D An Early History of Computer Game Input Devices[5]

The propensity of humans for using the objects around them for purposes of entertainment is reflected by the impressively rapid appearance of video games after the development of early computing technologies—which were, in a ironic twist, mostly products of wartime necessity. The first electronic digital computer ENIAC (short for "Electronic Numerical Integrator and Computer") was commissioned and produced by US Army's Ordinance Department in 1947 for the purposes of calculating firing and bombing trajectories for the Air Corps. In the same year, Brookhaven National Laboratory, a nuclear research lab, was founded, and soon employed computer mainframes similar to ENIAC for the purposes of developing particle accelerators, nuclear reactors, and advanced radar technologies. In its nascent days, the face of computer technology was grim, complex, and inaccessible; simply to activate and operate these computers took years of engineering expertise, and the vast array of switches and cable connections that one needed to manipulate in order to appropriately reroute cycling unit pulses and configure machine instructions was certainly inhospitable to play.

William Higinbotham's *Tennis for Two* control box (Hunter)

Eleven years later, in an attempt to project a positive social image, a Brookhaven physicist named William Higinbotham used mainframe computers and preprogrammed trajectory path information to create the first known video game: *Tennis for Two*, the progenitor of the *Pong* games that became hugely popular decades later. He designed two

[5] The accounts of Higinbotham's *Tennis for Two*, MIT's *Spacewar!,* and Baer's systems are paraphrased from Burnham's *Supercade*, unless noted otherwise.

"control boxes" outfitted with a knob and a button (which was used to serve the ball); these represent the first input devices designed for the purposes of computer gaming, as well as the first examples of the "joystick" controller model. Peripheral output came in the form of an oscilloscope display. The simplicity of the devices accorded well to their role as an "open house" exhibit, and the game became hugely popular to civilian visitors of the Laboratory.

A similar story came out of the Massachusetts Institute of Technology, where in 1961, a more accessible (but still incomprehensible to the layperson) computer—the PDP-1—fostered the development of a few seminal interactive computer games: *Bouncing Ball, Mouse in the Maze, HAX, Tic Tac Toe*, and Steve "Slug" Russell's historic *Spacewar!* (Meyers 49). Unlike previous games which simply adapted the PDP-1's console controls, the MIT team built control boxes for *Spacewar!*. This was done in response to a problem they had with using the regular computer terminal controls: with both players at the console, one player couldn't see the CRT screen as well as the other.

The creators of *Spacewar!* do battle. (Computer History Museum)

The third major development in the history of video gaming came courtesy of electrical engineer Ralph Baer in 1967. After realizing that "there were already over 80 million TV sets in US homes—and that they might be used as displays for playing games" (Burnham 17), Baer concocted a gaming mainframe (in the Three Agent sense) with accompanying input devices that could use any television to display its visual and auditory output. This device—known throughout its many incarnations as the Television Gaming Apparatus, the Brown Box, and ultimately, the Magnavox Odyssey—was remarkable not only in its marketing potential, but also in the design principles behind its input devices. Whereas the controls for *Spacewar!* and *Tennis for Two* bore an similarity to the input devices of the computers on which they ran, Baer's team created unique controls on a game-by-game basis, conforming the design of each controller to the actions involved in gameplay. Aside from the soon-to-be standard "TV Ping-Pong" archetype, which simply consisted of two knobs, there were a few controllers whose design reflected their literal function: the first "light gun" game (which eventually became the Odyssey's *Shooting Gallery*) was operated by a toy rifle; the game *Firefighter*, in which the player was to extinguish a figurative onscreen blaze, was operated with a button and a wooden "water pump" handle.

The early history of input devices reflects several well-established themes and ideas from the field of Human Computer Interaction (henceforth HCI). The first is a dialectic that becomes prevalent in the development of controller design principles: the tradeoff between usability and functionality. Knobs and buttons such as those used in *Tennis for Two* and *Spacewar!* represent a flexible, abstract, and utilitarian design ethic, in which controls can be adapted to many kinds of actions and different genres of games. The light gun and water pump, on the other hand, signify a more specific, literal-minded, and action-oriented design, one that emphasizes specialization over versatility and plays a more self-announcing role in gameplay.

Another thing to note about early games is a practice which, for practical reasons, has persisted to the modern day: the appropriation of general computing technologies for the purposes of gaming. This applies to both the mainframe components—for which purportedly professional devices like the Brookhaven and MIT computers were employed—and to their respective input devices. The current dominance of the mouse and keyboard as PC gaming devices is the clearest example of this practice, since they were not designed specifically with gaming in mind, yet almost every current PC game uses them. For obvious business reasons (eliminating the need to design and manufacture new hardware controllers, etc.), this has been a popular approach for platforms such as the cellular phone and the PC, but the precise repercussions of this approach are illuminated by HCI theory, and will be discussed in the following chapter.

II. HCI Theory and Device Interaction

> *It shouldn't surprise anyone that the trigger finger shows up so often as the major component of computer games. It's the extension of the keyboard, the repetitive* click, click, click *which very easily becomes* bang, bang, bang. *If id programmer John [Carmack] had been offered something else by way of interface, Quake 3 Arena would be quite different; it's as simple as that. But because we are constrained by our interfaces we build games which reflect our actual, physical relationship with computers. Give someone a trigger, and they'll build a gun.*
>
> —Mark Pesce, "The Trigger Principle"

Having established a useful conception of play and a general framework for discussion, I will now focus on theories of human-computer interaction (henceforth HCI) with the goal of examining how interaction with a computer device affects the experience of gameplay. HCI is a well-established field of academic study, and has led to the cultivation of practical technological implementation (the design of operating systems, I/O hardware, and other interfaces), as well as theoretical design (object-orientation, search, navigation). It has contributed to and borrowed from fields of inquiry including natural language processing, information theory, cognitive science, product design, and computer science. The scope of the HCI field extends to all elements of computer design to which the end-user is exposed; one definition describes HCI as "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" (Hewett et al.).

The game controller, as a subcategory of the input device (which, in turn, is a subset of the aforementioned "interactive computing system"), is subject to many of the same design principles and usability heuristics as any computing apparatus; this is especially true of those game devices that mimic or appropriate non-gaming devices such as computer mice and keyboards. Before moving on to how the gaming interface device in particular affects its user, this chapter will deal with the qualities that all interface devices share, as well as the exceptional cases in which the goals and purposes of play explicitly contradict those of general interface design.

As mentioned above in *I.D*, the design of controller devices has from the beginning followed two strains of development: the flexible, multipurpose strain represented best by the gamepad and mouse, and the literal, concrete strain exemplified by the light gun and steering wheel. The qualities inherent in the design of each of these two lineages are hardly accidental, as they happen to coincide closely with certain principles of interface design that tend to be placed in opposition to one another from a designer's perspective. For the sake of organizational clarity, it will be best if we characterize these two species of design separately, addressing first the issues of realism and usability, and then proceeding to their counterparts, abstraction and functionality. We will then consider the ways in which these schools of thought are applied to the design of controller devices.

II.A Usability and Realistic Controller Design[1]

Usability refers broadly to the qualities of a designed product that will allow a user to improve his/her performance at a given task (18). The criteria typically applied when measuring usability are "time to complete a task (efficiency), time to learn a task (learnability), and the number of errors made when carrying out a given task over time (memorability)" (ibid.); these concepts roughly correspond to the common computer

[1] The discussion of most HCI terms in sections II.A and II.B are paraphrased from Preece et al. unless otherwise noted. Page numbers are cited.

idiom of “user friendliness”. The light gun and steering wheel are examples of highly usable devices, in the sense that it takes a very short time to learn how to use them properly; their presence and popularity in mainstream arcades, where games are intended to be learned and played quickly, supports this assumption. (Since many of the following principles accord with Jakob Nielsen’s elegant “Usability Heuristics” (27), I will introduce Nielsen’s terms as related concepts are established in this section.)

The first and most obvious quality that makes the light gun and steering wheel controllers usable is that they mimic familiar items with a degree of *realism*, such that most people playing the game will know how to use the device by simple association. The relationship between real-world devices and their gaming-oriented counterparts may be conceived as an *interface metaphor*, which is “a conceptual model that has been developed to be similar in some way to *aspects* of a physical entity (or entities) but that also has its own behaviors and properties” (55). The social ramifications of designing one manmade object to mimic another will be discussed below in *II.C*, but where usability is concerned, it is simply a matter of leveraging the knowledge that players are likely to already possess, and “providing users with a familiar orienting device and helping them learn and understand how to use the system” (56). In a sense, the concept of the interface metaphor can be abstracted to most input methods, since their design often borrows from common mechanics: most people know that buttons are meant to be pushed, that knobs are meant to be twisted, and so on. However, using a player’s knowledge of similar devices extends beyond just how to operate the device, as it also consists of knowing what it is for; in other words, it is not enough just to know to pull the trigger of a gun, but also that to aim a gun at something and pull the trigger will generally destroy it. Thus, knowledge of usage and knowledge of purpose are separate, and both contribute to device usability. (Usability heuristic: "Match between system and real world"; 55) In essence, the advantages of realism are its ability to "enable people, especially computer phobics and novices, to feel *more comfortable* when first learning an application" (66), and its eliminating the need for tedious instruction and device training by "[tapping] into people's understanding of the real world" (ibid.).

There are other design principles which streamline usability, but do not rely on a user's previously learned notions and experiences. The term *affordance*, coined by product design theorist Donald Norman (25), refers to "an attribute of an object that allows people to know how to use it" (ibid.). However, in order to characterize the reasons exactly why people know how to user certain objects, Norman distinguishes between *real* and *perceived* affordances—the latter being an affordance that utilizes "learned conventions", and the former describing affordances that are "perceptually obvious and do not have to be learned" (ibid.). An example of a real affordance would be a door handle, which is at the right height and is of the proper shape so as to suggest a grasping action. It should be noted that affordances hint only at the physical usage of an object, and not the sort of knowledge of function which would complete a user's understanding of what the device is actually for. For example, the concave shape and convenient placement of the GameCube's shoulder button affords resting and pushing with the index finger, but there is nothing intrinsically informative about this button's function.

Whether real or perceived, affordances provide the player with an understanding of the relationship between physical action and game action. The concept of *mapping* describes the "relationship between controls and their effects" (23), which is of course crucial when designing for usability. This is not to say that *how* input becomes game action is important for the player to know; prefiguring how the hardware correlates to functions in the computer game is the task of the hardware engineer. An important thing to understand about the usability-oriented controller is that it creates the illusion of physical, non-virtual causality; this is known in HCI terms as *direct manipulation*, or the representation of an interface "graphically, in a form that matches the way one thinks about the [computational] problem" (Hollan et al. 90). In a more concrete sense, this concerns the user's qualitative feeling of "directness" and "engagement" (Hollan et al. 94), the sense that any actions performed on the controller are as if they were performed on elements of the game itself. For example, if a gun object in the game is manipulated by a light gun-type controller, the player experiences a stronger impression that s/he is actually using the virtual gun portrayed in the game. The controller acts as an extension of the game interface—a tangible, physically interactive component of the mainframe.

What the controller prohibits the user from doing is equally as informative as what the controller tells the user what to do. With a controller like the light gun, there are few input schematics to take into account: it demands simply that the user aim correctly and squeeze the trigger, activities which may be fairly challenging but not at all difficult to learn or coordinate. The light gun's physical design makes incorrect usage more difficult or impossible; for example, if a player unfamiliar with guns held a light gun by the barrel with both hands in order to aim it, it would make it impossible to squeeze the trigger, and since the weight is concentrated in the butt of the gun, it would make holding the device uncomfortably heavy. In this way, incorrect usage is discouraged, and the most useful and important functions on the device are also the most visibly prominent and obvious. (Related usability heuristics: “Error prevention”, “Aesthetic and minimalist design”, and “Recognition rather than recall”; 27.)

It would appear that the presence of usability- and realism- oriented controller design has been a matter of context. Today, controllers that mimic real-life objects are the centerpieces of commercial video arcades, with devices mimicking firehoses (*America’s Bravest*), soccer balls (*Kick-It Pro Soccer*), racing skis (*Alpine Racer*), and other familiar tools and objects in abundance. Arcade controllers that do not mimic real-life objects usually have any about 6 or 7 button inputs, and are typically arranged in a joystick configuration whose controls are highly visible and relatively large when considered alongside the traditional home console controller. Realistic and usability-oriented controllers for home consoles (light guns, steering wheels) tend to be associated with only a handful of games and often come pre-bundled with the associated games, so where home use is concerned, they are still found in the specific context of those games. It is interesting to note, however, that realistic devices are those whose functions and purposes are easiest to deduce outside of the context of their accompanying game.

Controllers of the early video game era were minimalistically designed for pragmatic reasons, as computing hardware prevented most games from having more than a few possible functions—the usability of those controllers merely reflected the simplicity of the games themselves. Processing power, however, has progressed by orders of magnitude, allowing games to feature near-arbitrary amounts of commands and functions. It is no surprise, then, that controller usability has been in steady and collective decline over the course of the mainstream controller’s history—from *Pong*’s single-knob interface to 2004's *Steel Battalion* (whose custom controller array includes 3 foot pedals, 34 buttons, a knob, two throttles, 5 switches, and a gear shift), the growing complexity of games has overwhelmingly shifted to a seemingly more complex, arcane style of input. This, of course, has been necessary for the practical demands of certain games and certain genres; whether or not these demands are intrinsically contradictory to usability-oriented design is a matter I will address after giving due consideration to usability's counterpart, functionality.

II.B Functionality and Abstract Controller Design

As mentioned above, if the light gun and steering wheel are tokens of realism and usability (in virtue of both their intrinsic and socially determined qualities), then the contemporary gamepad and keyboard are exemplars of functionality and abstraction. *Functionality* is a less rigidly defined term than usability, and even within the HCI community, individual definitions tend to diverge somewhat; like "play", it is a common term that people use and understand, but rarely bother to establish. HCI researcher Mike Kuniavsky defines it as "something considered useful by the people who are supposed to use it" (Kuniavsky 19)—this is a vague conception, and one in which users are the judges of functionality. Another definition characterizes functionality as "purely concerned with the functions and features of the product and has no bearing on whether users are able to use them or not" (UsabilityNet). Ultimately, we can distill these definitions to understand that they refer to the range, depth, and quality of functions in a device; we shall turn to the internationally standard definition, which remains neutral to the role of the user—"the set of attributes that bear on the existence of a set of functions and their specified properties. The functions are those that satisfy stated or implied needs" (ISO 9126 Standard).

It would appear that designing an object to be highly functional in all ways compromises usability. A highly functional object often requires a good deal of training and/or practice in order to learn how to execute each command, which reduces its learnability and memorability. For example, gear shifting is an additional skill that a user must learn to operate a manual automobile, and so more time is required to learn that action and more opportunities for errors arise, but the benefit is that the user has control over which gear the car may be in at any time. It is easy to see how efficiency may also be reduced, though this is by no means necessarily the case (as most experienced manual drivers can perform tasks just as quickly as drivers of automatics).

Multifunctional computing devices rendered the mimicry of familiar, single-purpose real world objects cumbersome and inefficient in many ways; interface designer Ted Nelson sees this approach as a means of "using old half-ideas as crutches" (qtd. in Preece et al. 57), and lists a number of tangible complaints against the use of interface metaphors as a design principle. Chief among these is the fear of transferal of "vestigial" design elements from the source design, which may inadvertently hinder the new device's utility; to use an exaggerated example, a handgun has a safety to prevent accidental discharge, but since this is less of a practical concern for the light gun (which doesn't fire anything deadly), it would be foolish to include this feature on a light gun. Of course, this is an easy feature to identify as superfluous from the outset, but others may be less so: is the trigger the best way of firing a game gun, or might a button allow faster firing rates and reduce fatigue? And if so, is the aesthetic value of using a trigger worth sacrificing usability? There is also the matter of inheriting design flaws present in the original object: “Trying to use a virtual calculator that has been designed to emulate a poorly designed physical calculator is much harder than using the physical design itself” (58). A third criticism of interface metaphors—and one that has a direct impact on device functionality—is their tendency to blind users to any features or inputs on the device beyond those obeying the metaphor (ibid.). A common feature of light guns is side-mounted buttons for actions like reloading or ducking out of the way (*Time Crisis* for the PlayStation); as the gun is a tool traditionally used for firing bullets, it may feel unintuitive for a player to use it for any other purpose—especially ones that do not fit into their already-formed conceptual models of firearms, such as the act of dodging. It is also awkward to reconcile non-literal function-action mappings (e.g. pressing a button to dodge enemy fire) to the literal, realistic functions that inform the very design of the controller.

All of these complaints provide compelling reasons why realistic, mimetic controller design does not mesh well with many modern, multifunction games, which is why we now turn to opposite of realism: abstract design. I use the term *abstract* here as a technical term, to describe interfaces whose design is not meaningful or informative outside of the context of an accompanying game. With abstract design, the precise usages, functions, and purpose of the controller are not intrinsically or obviously apparent; the meaning and function are instead supplied by games on a case-by-case basis. Indeed, there is an abstract component to most game devices, since they are essentially defined by their roles in the computer play act; even general computing devices like keyboards can shed many of their real-world usages and functions in the context of a game.

Having established the principles of abstraction and functionality, we can now discuss the more specific ramifications of their presence in controller design. The functional/abstract design paradigm's inherent flexibility is one of the reasons for its dominance in console and PC gaming. Because its inputs do not intrinsically suggest any specific type of action, a functional/abstract controller makes a greater range of activity-based conceptual models possible. A *conceptual model* is "a description of the proposed system in terms of a set of integrated ideas and concepts about what it should do, behave, and look like, that will be understandable by the users in the manner intended" (40). *Activity-based conceptual models* include all video game interactions, since some degree of player activity and control is a defining characteristic of computer mediated play. According to Preece et al., the four most common types of activities are *instructing*, *conversing*, *manipulating/navigating*, and *exploring/browsing* (41); I will not elaborate further here on the meaning of these terms, as they are sufficiently self-explanatory for our purposes. It is enough to see that while abstract keyboard/mouse or gamepad configurations can handle any of these modes readily, a usable/realistic controller like a light gun would have difficulty fulfilling more than one of these activities at once.

The nature of activity conducted in a game has much to do with what sort of role the player assumes in the game. Whether a spaceship, a rotund plumber, or a *Pong* paddle, many games either represent the player as a single onscreen character, or cast the player *as* the character. This is almost exclusively the case for earlier games, given their limited processing power and simple, straightforward design, which makes it easy to simply map inputs to different functions of the single character: one button makes the character jump, another makes it run, and so on. However, more recent games often have the player commanding or managing simultaneously a group or team of characters (e.g. *The Sims* and most sports games, and RPGs), individual structures and units of vast armies (*Warcraft*, among most strategy games), abstract or divine figures overseeing a world (*SimCity*, *Populous*), or even more abstract game elements that have nothing to do with characters (*Tetris*, *WarioWare, Inc.*). Even though these games often provide some sort of token character role (for example, casting the player as *SimCity*'s mayor, or as one of *Warcraft*'s heroes), the game actions are still not easily mapped from an individual human player to multiple- or non-human characters. This is especially true given the design of whatever controller is being used; the light gun—modeled after a tool used by individual people—would make a poor means of conveying player action in games that do not feature the actions of individuals. Thus, abstract controllers serve abstract and impersonal gaming elements well by not creating inappropriate or misleading associations: a realistic, navigation-oriented device such as a steering wheel does not accord to acts of instruction or group management, simply because it's not designed for such purposes. Abstraction eliminates user preconceptions; functionality then compliments this by providing diversity of and control over input types, which increases the number of possible button configurations and game actions executable at a given time. Abstraction and functionality accommodate heterogeneity of action in games by freeing the controller from the burden of prioritizing any one task at the expense of others.

Diversity and quantity of device inputs affect the condition of two related concepts: *task allocation*, or "deciding what the system will do and what must be left to the user” (258), and *computational offloading*, which occurs “when we use a tool or device in conjunction with an external representation to help us carry out a computation” (59). These two terms hinge around yet a third term—*modality*—which denotes the ways and means by which information is conveyed (Min 3). These three terms relate in the following manner: the less diverse and numerous the inputs on a controller (i.e. the less functional it is), the fewer the possible number of unique mappings the inputs may possess at any one time. For example, if the input consisted of a single button, that button may map to the in-game act of firing a missile, or making a character jump, or moving to the right, but it rarely does all of those things at once. Even if it did map to more than one activity—firing a missile *and* moving to the right—the player loses the ability to do just one or the other. Thus, the number of unique mappings to fulfill in-game functions is constrained, which is where modality comes in: by attaching several different modes to a single input, one button may signify more than one action, though not simultaneously. Suppose that every even number of times the player presses the button, the character fires a missile, but every odd time, the character jumps; in this way, the single control may accommodate more than one function (though not simultaneously, and with the awkward restriction of having to do one before the other). Adding another button, however, allows the player to do either without switching between modes. More inputs and types of input mean that multimodality is less necessary, more tasks are allocated to the user without the intervention of the computer, and there is more computational offloading. For example, instead of providing menus that represent action, a menu-based game interface (including most role-playing games, or RPGs) may map menu functions directly to buttons on the input device, an increasingly common trend in otherwise traditional console RPGs such as *Xenosaga* and *Chrono Cross*. The *Steel Battalion* controller has buttons dedicated to the in-game vehicle's fire extinguisher, windshield wipers, and eject function; this allocates the task of selecting these functions from the computer—most likely in the form of an in-game menu, given a standard gamepad—to the input device. This has the dual effect of reducing screen clutter and shortening the amount of time necessary to execute the functions; in fast-paced, real-time gaming, this can be a huge boon—ignoring, of course, the steeper learning curve associated with mastering the controls.

The *Steel Battalion* controller has dozens of dedicated single-function inputs. (Amazon.com)

Though it is undeniable that the range of functionality within games will increase as technology and market demand allow, there is also the possibility that the means used to access this functionality will be simplified. Task allocation goes both ways, after all, and designing an efficiently structured, yet complex game interface would relieve the burden of complexity on the controller, to a point. Ultimately, to accommodate the loftier designs of future game designers without resorting to an exclusive, highly technical computer gaming culture, we must consider ways to represent the best parts of the functional/abstract and the usable/realist models in a flexible, unified design.

II.C Reconciling Functionality and Usability

As we have seen in the two preceding sections, functionality often comes at the cost of usability, and vice versa; however, just because this is usually the case does not mean that it must be. For example, the amount of expertise required to operate a device properly is not always directly proportional to its functionality—a handgun is conceptually quick and easy to learn and operate, but actual skilled use of firearms is something that takes a good deal of expertise. Conversely, high functionality does not prevent an object from having easy-to-use functions: a bicycle with a horn is just as easy to ride as one without a horn. Though "usability" and "functionality" are conceptually distinct terms and should remain so, there is no reason that they must be placed in diametric opposition to one another, especially given the often nebulous definitions of "functionality"—one depicts functionality as a feature of usability (Kuniavsky 15), and another unites the two terms under a single, third term: *usefulness* (Usability First). Although I will abide by the definitions I put forth earlier, the point is that, far from being contradictory, the two concepts can be integrated in a single controller design.

The back of the standard Nintendo 64 controller. (photo by author)

The first notion that needs to be dispelled is the idea of the controller as a compact, discrete, hand-operated device; as the quote at the beginning of this paper suggests, there is no reason that this type of device should remain dominant, even considering its current popularity. In our interpretation, the controller is a conceptual entity which comprises *all* of the input devices used by a single player; therefore, controller input might consist of two or more familiar and usable devices in lieu of one multifunction unit. Steering wheel/pedal controllers are examples of this: the wheel controls direction while the pedals control velocity. Both interfaces are conceptually very simple and easy to learn, and while coordinating usage between the two may be trickier than either one in isolation, they are still quite usable. This plurality of simple input devices is common to many complex-real world machines, such as the automobile—the addition of the gear shift, turn signal, windshield wiper, and other simple devices barely complicates the act of driving much further, given some practice.

Combining functional and usable design has also been attempted with some success in mainstream console controllers. The Nintendo 64 controller's distinct three-pronged design affords three ways of holding it, since the center prong can be operated with either hand. The left and right prongs have "shoulder buttons" that are operated with the index finger; the center prong also has a button operated with the index finger, called the "Z-trigger". The trigger analogy is appropriate and quite deliberate, as both the ergonomic contours of handle and the placement of the index finger loosely mimic the grip of a handgun. This makes for an interesting overlap of realistic and abstract design: the trigger works intuitively with shooting games (e.g. *Goldeneye 007*) as a firing mechanism, but also mimics the usage of both of the shoulder buttons on the left and right prongs, creating a tidy symmetry of grip between both hands regardless of which two prongs are held. Thus, it is possible for realist and abstract design to converge on the same device—and even the same input—while drawing upon the advantages of each.

Optimally, a controller designed to be used for a wide range of games should not be equally functional and usable, but maximally one or the other as the game demands.

The Nintendo GameCube's controller is designed such that the easiest-to-reach buttons are the biggest; according to the HCI principle known as Fitts' Law, the time required to hit a target (e.g. a button, either onscreen or on a device) increases as the size of the target decreases and the distance needed to travel to the target increases (Fitts 381-91). The buttons further from the thumb's natural resting point over the comparatively oversized A button—X, Y, and B—are harder to press than they would be if the buttons were of equal size, and the less frequently-used directional controls are out of thumbs' way on both sides. This has the benefit of still featuring a fairly accessible and visible (with the help of bright coloring) set of inputs on the controller's periphery, while providing the option to ignore the harder-to-press buttons and simply concentrating on the highly-usable "central" controls (the A button, the shoulder buttons, and the left analog joystick). The concept of a "periphery" is key; having slightly-less usable controls that are still accessible allows a single device to boast basic usable controls and full functionality at the cost of the usability of only some of the controls. Edward Tenner succinctly summarizes this breakthrough in design: "it simplifies relationships for the beginner, yet allows masters to develop highly skilled techniques" (164).

The standard GameCube controller. (McCall)

Other examples of this sort of peripheral design rely not on the placement or selective emphasis of the inputs, but rather on the concept of *hidden affordances*: functionality that is not visible to the user, but which is capable of being used nonetheless (Wood and Skrebowski 76). Sony's Dual Shock 2 controller has 14 visible buttons (D-pad included), yet has 16 functional buttons: pressing down either of the two analog joysticks registers as a button press. These buttons are dubbed “L3” and “R3”, and are rarely necessary; however, for those games that do use them, they simply provide even more functionality, without visually complicating things for novice users. Additionally, most of the buttons are actually analog inputs: the input to the game corresponds in direct proportion to the force you exert on the buttons. Again, however, as this feature is typically used for advanced techniques in only a few games, novice users may treat the buttons as if they were digital (as gamepad buttons have previously been) without detriment.

The Dual Shock 2. The analog sticks may be depressed, and most of the buttons are analog. (amazon.com)

It should be noted that with some input modalities, compromising between usability and functionality may not be an issue. The functionality of voice input, for example, is constrained only by the programming of the software that interprets the input; the same goes for eye tracking, video monitoring (e.g. the EyeToy), and Vannevar Bush’s theorized direct neural interface. This is because functionality of the sort discussed above assumes an interaction between the player and the controller in which tangible physical interaction determines the input. Controllers such as those just mentioned, which take what I will describe as *ambient input*, essentially possess no inherent limits on functionality; however, that does not mean they are not constrained in other ways. The limitations of these controllers are merely shifted to the other two agents, the player and mainframe. The mainframe bears the non-trivial burden of interpreting often ambiguous ambient input and organizing it into well-defined input; this is especially noticeable in modern games featuring vocal input. Since technology currently cannot process natural language information with any great deal of accuracy, the games are often constrained by only recognizing a much smaller lexicon of recognizable words and phrases (e.g. *Hey You! Pikachu!*), or by processing only the non-linguistic components of voice, such as pitch (*Karaoke Revolution*). The player also possesses certain constraining factors, such as the inability to focus full attention on several sensory stimuli or trains of thought (Anderson 75, 103), to produce more than a few vocal streams in tandem, or to visually focus on many objects at once. For these reasons, ambient input devices may be theoretically unbounded in functionality, but are severely restrained by their usability in many contexts. Due to the specific modality of their inputs, there are currently many activity-based conceptual models that are not suited for ambient input, with perhaps the exception of the theoretical neural interface. Would anyone argue that voice input is the best way to move spatially in a virtual environment or convey commands in a fighting game? Indications that an industry-wide shift towards more complete, multimodal ambient systems is underway are beginning to surface. To quote leading Sony researchers at the 2004 Game Developers Conference:

> Some of the biggest changes, they assert, will center on the way players control and interact with games. Forget mashing the "X" button; future games will use cameras to read your body movements and facial expressions, plus microphones backed by advance speech recognition technology to recognize vocal commands…
>
> …"All these sensors are unified, and the computer is doing the hard work to put it all together," said Dominic Mallinson, manager of special projects for Sony Computer Entertainment America…
>
> …The researchers hesitated to make predictions much beyond the next couple of decades, but Mallinson said it seemed entirely feasible that by the time the PlayStation 9 rolls around, technology will allow a direct connection between the game console and the player's brain. (Becker)

The obvious parallels to Vannevar Bush's direct neural interface reaffirm the appeal that such a device holds for game designers, since by removing physical input constraints, functionality and usability are no longer in opposition of any kind, and the task of determining ease and complexity of use is determined entirely by the programming of the game and the ability of the player.

II.D Designing for Play

The essential difference between designing devices for general purposes and designing devices for the purpose of play is that for the latter, the computing act is an end in itself: it is the play act. The engineering culture from which technological devices emerge typically conceptualize computers as tools for enhancing human capabilities, performing rote and routine behaviors automatically, or completing practical tasks; play devices, on the other hand, are simply used for the sake of being used. In Konami's *Dance Dance Revolution* game series, users revel in being able to successfully and even gracefully input their commands into the foot-operated input device. Given Fitts' Law and the naturally superior dexterity of the human hand, the efficient device to use for a game of this type would be hand-operated, since less movement and exertion would be required of one's fingers than from one's legs. However, the device is not designed for usability; it is designed to provide the unique challenge of following real-time commands with one's legs, devising ways to make one's own usage as efficient, impressive, or even aerobic as possible. Although enjoyability has been cited as a "user experience goal" in HCI design (Preece et al. 18), it has generally been for the purpose of encouraging repeated device usage or avoiding user discomfort. Only recently has the idea of making interfaces that prioritize enjoyability over efficacy become popular. Donald Norman, a prominent usability researcher, makes the following claims in his book, *Emotional Design*: emotionally appealing objects are perceived to work better (18); device users want to feel a sense of accomplishment, even at the cost of convenience (56); and that the faults of enjoyable devices are often overlooked (25). Cultural psychologist Mihaly Csziksentmihalyi hypothesizes that difficulty or tedium in performing a task does not diminish its enjoyability, but rather focuses one's mental energies to an enjoyable state of heightened consciousness and decreased self-awareness—what he calls "optimal experience" (39-42). A similar claim is made by Edward Tenner, who points out that more efficient variants of devices, such as Paul von Janko's musical keyboard, have failed because musicians of that age wanted their music to remain difficult: "The tension and struggle of the pianist to control the instrument and hit all the right notes contributed to the excitement of the concert and serious amateur performance" (177). Tenner continues, "music is not just a proficiency contest" (ibid.); in the same way, play is not just about completing a game with the most ease; after all, difficulty settings are placed in game for a reason. Designing systems that are easy to understand, yet "non-easy" to use may "[provide] opportunities for quite different user experiences from those designed based on usability goals" (Frolich and Murphy). One brief example of this is the *Steel Battalion* controller's "eject" button: it is covered with a small plastic guard, which the player must flip back before pressing. The guard serves no functional purpose, and in fact impedes player reaction time in urgent situations; however, it is there to impose a

A *Dance Dance Revolution* arcade machine. (Fwworld.com)

physical challenge, as the player must anticipate sooner when s/he must eject their vehicle, in order to compensate for the impediment. This physical design aspect increases the game's verisimilitude and encourages a mindset of combat strategy and awareness which, not surprisingly, is the type of playing that this game requires and rewards.

II.E Standardization versus Innovation

A device's functionality and usability is not measured outside of a cultural context; though a device is always designed with a specific user in mind, one must take into account that the skills and culture of the user are constantly evolving. When Nutting Associates' *Computer Space* coin-op was released in 1971, the pre-digital American audiences found its four-button controls too difficult to operate (Shulgan). Given the complexity of the modern console controller (currently about fourteen buttons and two analog joysticks on average), which enjoys massive popularity in industrialized nations, there has evidently been a steady and widespread increase in usage sophistication. As each new generation of gaming devices has been released, gamepad controllers have grown in complexity, featuring greater functionality than previous incarnations. Yet this complexity has clearly not alienated or discouraged a mainstream audience, as the number of gamers has steadily increased. This evolution of usage is the topic of Edward Tenner's *Our Own Devices*, in which he describes the interdependent relationship between an object's usage (the "body techniques" that users develop) and its design in what he calls a "dialectical flux" (29). We see this in the history of gaming: as *Pong*'s single-knob controls gave way to the multiplicity of buttons, whole-hand technique has correspondingly adapted itself to the use of individual fingers and thumbs. Tenner characterizes new technological paradigms as products of two competing forces: cultural familiarity and affinity, and adaptation and innovation (xii-xv). To paraphrase the book's thesis: his belief is that social and environmental changes create new necessities, and as a "response to a desire for new expressive possibilities" (165), appropriately novel devices are invented to accommodate them. However, people are typically loath to abandon the devices to which they have become accustomed, and dislike learning new sets of techniques to replace ones that they have already mastered. Thus a compromise must be made between these two forces, and the resulting devices either fulfill such a unique or urgent need that people adopt them at the cost of acquainting themselves to an entirely new paradigm, or the device adheres to the familiar design characteristics of other established devices.

Clearly, it is the latter design approach that predominates, as "few users are willing to relearn techniques in the absence of discomfort" (Tenner 265). As gaming and computing are not typically sources of discomfort, interface designers instead take to following standards of configuration and usage—abiding by standards happens to be one of Jakob Nielsen's usability heuristics (Preece et al. 27). We have seen how the general shape and layout of the gamepad has remained consistent, with primary directional controls on the left and function buttons on the right; we can also see how the nomenclature of certain buttons has remained consistent: "start" has become a standard name for the button placed at the center of the gamepad, and "L" and "R" have been used to denote shoulder buttons. Those are examples of configuration standards, which dictate the appearance of the controller and allow potential users to know the purpose of the device at a glance. Usage standards concern how controls map to common in-game functions—the WASD configuration for FPS games is one example; the traditional use of the "start" button to pause a game-in-progress is another. Usage standards are determined by the game designer, but the hardware designer must be cognizant of certain functions, like those just mentioned, because they are so persistently entrenched, recurring, and even stereotypically characteristic of the medium that to ignore them is impractical. Interestingly, using certain standard controller devices with specific game genres can, over time, overcome the usability benefits associated with realistic design. For example, the mouse/WASD keyboard setup has become so familiar to players of first-person PC shooters that products such as Monster Gecko's PistolMouse FPS controller seem intuitively unnatural, despite that their design more closely resembles their function.

The PistolMouse FPS controller. (gogamer.com)

Given enough exposure and acceptance, standards allow abstract designs to become concrete and possess meaning; eventually, in the same way that helmets represent safety, devices with standard designs come to emblematize their functions. In this way, a controller device like the gamepad is no longer a purely abstract construct, since its design is informed by other, pre-existing gamepads; abstract and real designs thus become reconciled. Standards also facilitate the learning of techniques, since only a handful of new techniques must be learned with every new generation of device, and they promote the transferal of technique expertise between devices of similar design.

The disadvantages of standardization are significant: as in the case of von Janko's musical keyboard, dogmatic adherence to one design model for a long period of time ignores any new needs and changes that arise (a phenomenon commonly known as "path dependence"). As Tenner explains, "One challenge of advanced industrial societies is a degree of standardization that threatens to choke off both new technologies and new techniques" (267). Furthermore, habituation to standards becomes increasingly difficult for users who were not familiar with the original, simpler usage models; those previously unfamiliar with the typewriter will find learning the computer keyboard that much more difficult. This becomes a problem when technologies that are designed and refined for a certain audience (e.g. businesses, America, males) branch out to a larger, neophyte audience. A sharp break from standards—that is, innovation—is necessary every once in a while simply to represent the optimal way of handling the current problems of computation, which in the context of gaming are represented by the demands of the games that are being produced. Tenner summarizes this conflict with the epigram, "Design should not only be user-friendly but user challenging" (ibid.). The importance of maintaining a challenge is especially relevant to play, where it is necessary to keep players from becoming bored and thereby defeating the purpose; if Csikszentmihalyi's theory that performing an activity (e.g. using a game controller) decreases its challenge (74-75), then the periodic innovation of the controller may even be necessary to sustain the challenge (and hence the entertainment value) of established game genres.

In contrast to the dialectical flux of technique and technology that Tenner establishes (22), the development of input devices is a three-way dialogue between each of the three agents in our model of computer-mediated play. The player's skills, techniques, and physical construction dictate how the controller must be designed, which in turn constrains the functionality of the mainframe that corresponds to that controller. Conversely, the needs of new genres and generations of mainframes often demand more advanced functionality of the controller, which force the player to learn and adapt to the new design. Where conflict between innovation and familiarity is concerned, the controller is not just the physical but the conceptual intermediary between player and mainframe, and its usability and functionality must conform to meet the needs of both.

II.F Aesthetics and Controller Design

Edward Norman's dictum—that, all other things being equal, attractive objects are easier and more enjoyable to use (18)—seems at first to be the most immediate concern of cultural interface design. Since attractiveness is a culturally variant value, it is difficult to produce any sort of middle ground to satisfy any gaming audience at large. Yet the problem of attractiveness would seem too important to ignore, if we are to believe that the attractiveness of an object creates a "halo effect" which influences how reliable, useful, and effective an object is perceived to be. It seems that the companies responsible for video game device design are aware of this: announcing the release of the new Aqua-colored version of the PlayStation 2 console in Europe, Sony's press release gushes that the new design "will complement any modern design-led living room environment" and "[offers] users the fun of choosing their favourite colour that matches their taste and fits the room decoration" (DreamStation.cc).

Norman's solution to designing for attractiveness extends far beyond color coordination; he proposes to abandon the notion of a single all-purpose design that caters to everyone's tastes and instead create a multitude of specialized devices, each with their own usage, function, and audience (45). Complaining that today's video game device is targeted exclusively at "young, excitable males", and that controller design is dominated by the idea that "skill at operating the controls is one of the features distinguishing the beginning from the advanced player" (44), Norman envisions his ideal design paradigm:

> …the potential uses of video games extends [sic] far beyond the playing of games. They could be excellent teaching devices….
>
> The device that used to be specialized for the playing of video games takes on different appearances, depending on its intended function. In the garage, the device would look like shop machinery, with a serious, rugged appearance, impervious to damage… In the kitchen, it matches the décor of the kitchen appliances and becomes a cooking aid and tutor. In the living room, it fits with the furniture and books and becomes a reference manual, perhaps an encyclopedia, tutor, and player of reflective games (such as go, chess, cards, word games)… Designs appropriate to the audience, the location, and the purpose. (45)

Though Norman's vision of the helpful computer assistant is tantalizing, it is flawed where design for controller devices is concerned. First, given the definitions we have established for this paper, the products he seems to be describing would not be considered computer game devices at all, since the primary purpose he is envisioning for them is not play but education and reference. Computer games may certainly have the capacity to educate (as we will discuss in chapter IV), but a game is for most purposes defined by its role in play, and Norman seems to subordinate this important role to other interests.

Moreover, there may be evidence to suspect that culturally-attuned attractiveness does not always favorably increase usability. Graphic designer Aaron Marcus designed two software interfaces with identical functionality, but whose appearances were tailored to different cultural demographics: a minimalist, business-like presentation for adult

European males, and a detailed, rounded, and more graphical layout for white American females[2]. When tested, however, both groups overwhelmingly liked the simpler layout better, despite Marcus's stylistic hypothesis (Preece et al. 144).

So aesthetics may not be as critical an asset to usability as Norman claims, but its role cannot be discounted in a device designed for play and enjoyment; the question now is, exactly how important a role does attractiveness play in the overall utility of a controller? The answer, of course, depends on the device under consideration; appearances may play a greater role in some types of games than others, and it may be more or less of a concern to different player audiences. In contrast to Norman's dogmatically aesthetic approach, Preece et al. offer a more measured take on aesthetic design: "The key is to get the right balance between usability and other design concerns, like aesthetics" (144).

II.F Culture and Usability

***Taiko No Tetsujin 6* arcade machine. (Broyad)**

Earlier in the chapter we briefly discussed the impact that cultural context may have on controller usage: if users are unfamiliar with a certain device paradigm, or lack the cultural knowledge to identify a certain object's usage and purpose by visual recognition alone, then many of the benefits of realistic controller design are lost. It is clear that the primary

[2] The validity of this gender-tailoring is at least corroborated by similar gender design techniques in products such as shaving razors (Zarza 6), handguns (McKellar 72), and myriad other consumer products.

disadvantage of realistic design is the risk of alienating users unfamiliar with the object being modeled, since the objects and their usages are culturally determined; this problem is fairly common, owing in part to the wide transpacific cultural gap between the two major centers of game development, America and Japan. Recent games—such as Namco's *Taiko no Tatsujin* series, which uses a set of Japanese Taiko drums and drumsticks, or Konami's *Para Para Paradise*, whose controller is a set of motion sensors—have so far been confined to the Japanese market, for related reasons. The latter relies on the player's familiarity with the popular form of Japanese pop dance, "Para Para", which involves complicated movements of the arms. The former is a little more subtle: although drums and drumming are familiar activities to Americans, Taiko drumming is different in many ways, such as how it distinguishes between whether the drum hits are made on the wider Taiko drum surface or the rim (Gerstmann); also, the game distinguishes between beats made by using one or both drumsticks. Neither of these purely cultural distinctions is immediately revealed by the visual design of the drums, and so even though the American player may recognize that they are meant to be struck with the sticks and that they are meant to create music, s/he would still probably use it incorrectly on the first few tries without explicit instruction.

***Donkey Konga* controller. (Hume)**

A clever antidote to *Taiko no Tatsujin*'s transcultural gap was established by Nintendo's *Donkey Konga*, a game with an almost identical onscreen interface, but with a controller that instead resembles a set of conga drums. The game is played with the hands instead of sticks, and players hit left and right drums, instead of hitting the side rims of a single drum as one would in *Taiko no*

Tatsujin. Moreover, instead of hitting the drum with both sticks, players clap, and the sound is picked up by an attached microphone and translated into game input. *Donkey Konga* is an excellent example of an interface which has been repurposed for the needs of a specific culture without drastically altering the concept of the game.

There is less national or ethnic variation in computer games when compared to other media such as television, literature, movies, and music[3]. This may owe to the fact that the overwhelming majority of games and game systems are produced by only a handful of countries, and that the computer game industry has exposed all of its international markets to a roughly similar body of games and game devices. As a result, there is not currently much to speak of ethnic variation in controller design, but there are two gamepads that might be compared in ethnic terms due to their geographically distinct origins: those of the Xbox and the GameCube. The American-made Xbox controller has a distinctive silhouette, prominently features the jagged X logo, and has a conspicuous matte sheen; noticeable above all else, however, it is dramatically larger than the GameCube's and PlayStation 2's—the major Japanese controllers. The controllers' size disparity may in fact stem from and reflect the body techniques of their respective nations of origin; Tenner argues that Eastern cultures possesses an athletic "tradition of lightness and maneuverability", in comparison to the heavier, more explosive style of the West (27). The Xbox controller design, compared to that of the GameCube, would appear to support this hypothesis. Further reflecting this consideration of cultural difference is Microsoft's decision to design and release the "Controller S" model for the Japanese market, the main difference being a considerable decrease in size and weight. It also appears to be less conspicuous than its American counterpart, with a slightly more matted

The standard Xbox controller. (Mucknuggle)

[3] Though, given the current trend towards globalization, these media may soon be as culturally neutral as computer games presently are.

finish and formless contour. The official rationale Microsoft provides for this redesign is that the Japanese hand is generally smaller (Davis), which seems plausible enough but does not account for the high subsequent demand for Controller S's US release. Microsoft complied, altering only the center logo and the digital directional controls for the American launch; the Controller S now greatly surpasses its counterpart in popularity in both countries.

Other examples of cultural differences in controller design concern the perceived attitudinal differences between cultures. One example involves Konami's *Fighting Mania* arcade game, in which players physically strike the punching pads on the game cabinet in accordance with onscreen action. When the game was released in Europe, the cabinet was redesigned with structural reinforcements; according to Andrew Muir of Konami of Europe, this redesign was done with the explicit justification that "European players are physically bigger, and there is not as much respect for property in Europe as there is in Japan" (qtd. in Nolan 33). Much like the rationale behind the Xbox controller's redesign, this quote reveals that cultural perceptions on the behalf of the designers play a role in the appearance and utility of game devices.

The European *Fighting Mania* game cabinet. (Nolan 33)

II.H The Semiotics of the Controller

In terms of cultural meaning, the controller device reflects not only understandings of how computers are operated, but also a culture's notions of what computers and computer games are. Owing to the lack of ethnic variation mentioned in the last section, the most definitive cultural category in the design of video games is not national or ethnic, but rather, epochal. This being the beginning of digital computing's consumer age, what game controllers of every form represent is the postindustrial human's simultaneous faith in and paranoid fear of technology; as Brian Sutton-Smith summarizes, "Video games are, among other things, a human response to the fear of the great machine" (67). This dichotomous relationship between people and their tools has deep roots in history: from the Luddites of 1811, who destroyed tools of manufacturing in order to salvage their own jobs; to the savior/destroyer role of the atomic bomb in World War II; to the fictional robotic wars envisioned more recently by popular movies like *The Terminator* and *The Matrix*, the machine has always represented a threat to any culture on the cusp of technological revolution. At the same time, it is not difficult to discern the omnipresence of technology, which speaks of its immense usefulness to the very humans who fear it.

The video game device applies the novel tension of play relationships to this familiar attitude of ambivalence. Human trust of the device is exemplified by the player's willingness and implicit trust that the controller will convey his/her actions accurately to the game state. A game is partly defined by a rigid set of rules, and the player entrusts the role of overseer and referee entirely to the game machinery, knowing that the computer cannot cheat unless programmed to do so (in this way reminiscent of game theory's "rational agent"). At the same time, the relationship of fear in the man/machine exchange is manifested by the tension presented in the game, which typically can be either won or lost to some degree, and which often provides a competitive context. Given this tangible competitive framework upon which to articulate the conflict, the game controller represents the physical representation of a human agency in the virtual world; it is the symbol, literally, of a player's control. This explicit manifestation of control is probably no accident; as Csikszentmihalyi and Rochberg-Halton argue, "In almost every culture, objects are chosen to represent the power of the bearer. More than any trait, the potential energy of the person, his or her power to affect others, is the one that is symbolically expressed" (26). It is often noted that one of the primary characteristics of an enjoyable activity is a sense of control and of "[going] beyond the boundaries of normal experience" (Csikszentmihalyi 72); Sutton-Smith applies this notion to video games: "…it is the player's control over the machine that is most emphasized by those who play these games" (67).

Objects like the controller, whose essential and sole function are to assert one's action in virtual worlds, take on a talismanic significance:

> …an expression of Eros in the broadest sense, a need to demonstrate that one is alive, that one matters, that one makes a difference in the world. Because of their physical structure, objects lend themselves to the expression of raw physical power. From the spear to the airplane, they can act as levers that increase a person's strength or speed—his or her kinetic energy. But there are also more subtle aspects of the self that can be expressed through the medium of objects. Magic powers, based on a human's presumed close relationship with supernatural forces, are stored in "power objects… In all cases where actual physical objects become associated with a particular quality of the self, it is difficult to know how far the thing simple reflects an already existing trait and to what extent it anticipates, or even generates, a previous non-existent quality… Without doubt, things actively change the content of what we think is our self and thus perform a creative as well as a reflexive function. (Csikszenmihalyi and Rochberg-Halton 27).

It is precisely the controller's ability to grant humans control of virtual game objects and game abilities (arguably an expression of dominance engendered by machine fear) that cement its role as the modern power object. The power granted by the controller is that of mastery over information and the Machine, the great post-industrial Other; using the game controller as the proverbial bridle and harness, humans are given a physical sense of amplifying and augmenting one's human capabilities with technology—as the Nintendo slogan pithily summarized, "Now You're Playing With Power".

Where the game device is concerned, the stakes of the man/machine clash are not as dire as, perhaps, the more recent struggles enacted on the chess board by Garry Kasparov and IBM's Deep Blue computer, which *Newsweek* magazine hyped as "the brain's last stand" (Levvy), but that is because the player/controller relationship is not one of pure opposition; rather, it is one of transition. The controller takes commands from the player, even as it enforces any limitations on action established by the computer; for example, striking a digital button with all of your might will not make your character react any differently (analog, however, is a different matter). Ultimately, the controller is not only an object of mediation—a neutral mechanical wall between mainframe and player—but a mediator, an entity that belongs equally to the human and digital worlds, reconciling the two, uniting them.

II.G Social Roles and Cues in Human-Computer Play

An ongoing debate in HCI concerns the impact of attributing, either consciously or unconsciously, human traits and qualities to computer technology. Because the governing principles of human etiquette and interpersonal behavior so heavily influence how people treat other people, the unconscious transferal of these principles to artifacts carries immediate consequences for player interaction with input devices.

HCI researcher Clifford Nass has extensively studied the ways in which people employ social behavior when using computers; his main finding is that "*All* people automatically and unconsciously respond socially and naturally to media" (Nass and Reeves 7). In their study of unintentional social behavior on computer usage, Clifford Nass and Youngme Moon use the term *ethopoeia* to describe the phenomenon of "direct response to an entity as human while knowing that the entity does not warrant human treatment or attribution" (Moon and Nass 96-7). To act polite to a computer despite knowing that it has no human feelings that could be offended is an example of an ethopoetic social response, one that is, in fact, common (Nass and Reeves 23-28). The presence of ethopoetic phenomena suggest that, without bearing any perceptual traits uniquely characteristic of "humanness", game devices can elicit human social responses, which may in turn affect how games are played. While Nass and Moon's study primarily concerned semantic interchanges between users and software interfaces, the notion that there might be similar relationships between the human and the interface should not be discounted.

Nass and Moon point out that gender is one of the most "psychologically powerful" categories where eliciting social cues is concerned (Moon and Nass 84); as inherently neuter, nonliving objects, ascribing gender to computer devices is strictly ethopoetic. However, to characterize the computers in their study, they used male and female voices to convey information to the user; a game controller does not have the same sort of direct means of conveying gender. However, whether intentional or inadvertent on behalf of the designer, there are many ways that the controller is or could be gendered.

First, by being symbols of video gaming, controllers like the gamepad and joystick are already subject to the cultural stereotype of video gaming in general, which renders the gaming demographic as Norman's "young, excitable male". Brenda Laurel has remarked that "…from its inception, everything about the computer game industry actively excluded girls" (par. 3). By mere association, controllers become objects used exclusively by males and therefore possessing traits of masculinity.

Physical design may also evoke gender associations, not by directly insinuating or simulating sexual traits but by exploiting culturally-designated gender stereotypes. Gender tends to be physically represented in very specific and dichotomous terms: fragile or tough, soft or hard, sweaty or fragrant, bright or dark colors. In America, femininity is typically denoted by means of "soft colors, curved lines, and natural references" (Zarza 6), and more generally, a "softer, less threatening appearance" (McKellar 73); adopting these characteristics in their design, controllers can (and arguably do) connote gender designations. By these standards, the smaller, brightly colored, curvilinear design of the GameCube controller might be evaluated as more "feminine" than the bulky, self-announcing XBox controller.

Finally, the sheer nature an object's function may have a gendering effect, though for the game controller, this function varies. Might a joystick be construed as a representation of the phallus: a proud, vital, aggressive "extension of the self" (qtd. in Csikszentmihalyi and Rochberg-Halton 26)? This may seem farfetched, but another phallic, inanimate object—the spear—has been characterized by Csikszentmihalyi and

Rochberg-Halton as follows: "…the spear exaggerates and demonstrates to everyone those personal traits that the owner—and the rest of the culture—aspire to: strength, speed, potency, permanence; the ability to command respect, to control one's surroundings" (27). This conveys almost exactly the function of the generalized video game controller, though the powers it "exaggerates and demonstrates" are virtual rather than physical; the controller fulfills the "instrumental" male gender role, in which objects are coded and identified by "exertion toward a goal of physical and mental supremacy" (106-107). In another sense, though, the controller is a receptive instrument, used as a tool to support the player's powers rather than directly assert them, and wholly dependent on the player's input to have any function. This might rather bring to mind stereotypes of female passivity and receptivity, or of females playing support roles, and not possessing self-directed agency. In a more positive (but still socially scripted) sense, the "expressive" feminine role, which values social ties, connections, and the "network of relationships" (110), works well with the idea of the controller as a link between the player and the game intelligence.

In any case, we have established that gender may express itself in indirect ways. Without going into detail, we can state that ethnicity and group identity may also be expressed by appearance, associations, and cultural designations. Moon and Nass have furthermore established that the perception of gender, ethnicity, and group identity in computers triggers ethopoetic social behaviors on the behalf of the user. So what are these behaviors?

Their research suggested the following about gender: aggressive or assertive behavior expressed by devices perceived as male is received more favorably than the same behavior expressed by a "female" device; gender-stereotyped information is judged as more informative when delivered by a device of according gender; and that devices using male voices to deliver praise were more competent and compelling (Moon and Nass 84-5). The trustworthiness and convincingness of peripheral feedback and the perception of controller usability, then, are both subject to gender ethopoeia.

Where ethnicity and group identity were tested, Moon and Nass found that when the ethnicity or identity of the device matched that of the user, the device was perceived as "more attractive, trustworthy, persuasive, and intelligent, and as making a decision more similar to their own, compared to those in the different-ethnicity situation" (87). The X-box/GameCube contrast mentioned in the previous section is one example of ethnic manifestation in design; the idea here is that ethnicity may not only play a role in how the controller is designed, but how it is perceived and used by the player. A player who observes a sense of Tenner's Asian "lightness and maneuverability" in a GameCube controller's design may, if Moon and Nass's research were to apply to the game device, be inclined to react more positively to the controller if s/he believes that it matches his/her own play style or is appropriate to the type of game being played. For example, a player who typically chooses to play in an aggressive, hard-hitting, direct manner, the GameCube design style may seem less well-suited to the task, even though it is functionally similar to the bigger, heavier Xbox controller. This perception would, of course, have a tangible impact on the subject quality of play; if the player believes s/he is using the best tool for whatever task s/he is using, then the play may be more confident,

The Xbox Controller S. (Abel)

and the player may be more inclined to believe that his/her skills are being translated accurately to the game.

It is harder to apply Moon and Nass's other findings to current game controllers, since they mostly concern social aspects expressed verbally: politeness and reciprocity. These are hard for a game controller to express since they are intended as devices to be used *by* the player, rather than devices doing things *for* the player. However, with the predicted future trend of the "personal entertainment robot" (Becker), it is not inconceivable to imagine devices that perform actions independently, engendering politeness reactions in players. Nintendo's "R.O.B. the Robot" was one simple example of such a robot, performing a small set of actions in real life that corresponded to actions onscreen. The effect most important to game playing that Moon and Nass attribute to reciprocity is the user's greater accuracy and willingness to work harder on tasks using a device when s/he has perceived that the device has done him/her a favor. This has tangible ramifications for performance in a video game, where the amount and quality of actions done affect the game results directly.

There are also a few more factors to consider when the relationship between user and device is not ethopoetic, but anthropomorphic. *Anthropomorphism* is a separate phenomenon from ethopoeia; in both, people ascribe human qualities to non-human objects, but the term "anthropomorphism" denotes a "thoughtful, sincere belief" that the object has human properties and "warrants human treatment" (Moon and Nass 96). The extent of this belief does not need to be total, but regardless, the effects of anthropomorphism are much stronger in children, for obvious reasons; among most people, true anthropomorphism is rare (Nass and Reeves 11). However, there may be reason to believe that when a machine exhibits certain human-like behaviors, people can be compelled to “[attribute] greater intelligence or intentionality to a machine than it possesses” (Murray 224). This is known as the “Eliza effect” (ibid.)—so named for the computerized psychotherapist that famously fooled many people into believing that it was human—and Murray ascribes this phenomenon to “the human propensity to suspend disbelief in the presence of a persuasive dramatic presence” (ibid.). Because of the computer medium’s capacity for expressing human-like behavior (Eliza being a simple example of this) and dramatic presence (the basis of most role-playing games), anthropomorphism may be a more common phenomenon in human-computer play than in the more general computer usage settings that Nass studied.

Nintendo’s R.O.B. the Robot. (Hack)

Therefore, although most instances of social effects in device interaction are ethopoetic, there are differences that should be accounted for in the cases where anthropomorphism does truly occur. Praise or positive feedback from an anthropomorphic device is evaluated differently in many ways: it is received more favorably by the user; the user is more willing to work with the device, and for longer periods of time; and users tend to interact more, and make fewer mistakes (Preece et al. 156). In the context of gaming, one may view various forms of controller-integrated peripheral output as feedback or “praise”: haptic feedback, pleasant sounds, or other agreeable sensory output. People often expected a wider (i.e. more human) range of function than the device provided, a common interface metaphor dilemma—“In particular, [users] expected the agents to have personality, emotion, and motivation” (ibid.). Finally, in a survey of college students, an anthropomorphic interface, compared to a "mechanistic" one, made the users feel "less responsible for their actions"; this pertains directly to the gameplay experience. The illusion of agency in a video game is not only intimately tied with the amount of satisfaction one derives from achieving goals and making progress in the game, but also affects the game's "immersive" aspect (a term which will be discussed in the following chapter):

> …most games advertise that the player is in active control of the events and attempt to create the *illusion* of control… they invite the user to suspend his or her disbelief with respect to the range of control… in order to establishing [sic] a more compelling *immersion* in the gameworld." (Davis 48)

A generalization one may draw from all of these social effects is that players tend to prefer congruency and harmony between player and controller, and controller and mainframe. As B.J. Fogg demonstrated in his Stanford Similarity Studies, a match between the user's and the computer device's personalities, identities, or group affiliations produce the perception of overall similarity and better functioning in the user. In effect, players seem to cherish unity between themselves and their controllers.

As we will see in the following chapter, bridging the gap between player and controller may be achieved not only by cultural means but by much more visceral processes of the brain and body; we will also see that uniting the player with the controller is less figurative than one might expect. We will begin to shift away from the familiar traditional model of device interaction that we have mostly addressed in this chapter and start to address new modes and conceptions of technological usage. This section will deal with a view of technology as an extension or modification of the human, and how this opens up new opportunities for play by redefining the relationship between human and computer as a cohesive whole, rather than as necessarily discrete entities in a system of interaction.

III. The Cyborg At Play

Today, after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned. Rapidly, we approach the final phase of the extensions of man – the technological simulation of consciousness, when the creative process of knowing will be collectively and corporately extended to the whole of human society, much as we have already extended our senses and our nerves by the various media.

—Marshall McLuhan, Understanding Media (3-4)

The narrative of cyborgs and cybernetics is well-known in the American mainstream, especially in movies and television: a human being—say, The Six Million Dollar Man, Doctor Octopus, Neo—is given fantastic powers with the aid of advanced technology integrated into or attached to the body, under the full command of his/her sheer will. A more formal definition describes a cyborg as "a human who has certain physiological processes aided or controlled by mechanical or electronic devices" (Heritage), and cybernetics is the field of study concerning the development and implementation of these devices. Although its connection to the body is typically (but not necessarily) temporary and non-invasive, there is no compelling reason not to regard the video game controller as a type of cybernetic enhancement, since in a virtual sense it fulfills many of the same functions. There are controllers that augment the parts of the body used to operate them: with a gamepad, the thumb is conferred the ability to make Mario jump, while a keyboard grants the player's fingers the power to navigate virtual spaces. The controller, then, is a physical representation of possible game actions, with each of its interactive pieces and widgets mapping to an in-game function, enhancing the capabilities of whichever part of the body is operating the controller. And then there are controllers that serve as figurative extensions of the player's mind by altering one's subjective perceptions, creating an experience of play qualitatively distinct from that of unmediated play. Rather than necessarily adding a degree of distance between the player and the mainframe, as one might intuit, the controller can contribute to a sense of involvement with the task at hand, potentially creating a more satisfying, convincing play experience.

III.A Neural Interfaces vs. Close Interfaces

Let us return to Vannevar Bush's speculation on future interface technology, in which a typist's neural impulses, linked to her intention to perform a typing action, are rerouted to directly convey the typing action via some mechanical interface. Here, we have something closer to the popular notion of the cyborg, a being that integrates technology into its body to supplant or bypass its natural physical limitations. But what benefits would such an interface provide over traditional input devices? Would performing the action of typing in such a direct manner influence the content of what is written? Legal, practical, and bacterial risks aside, what does it mean to be intimately joined with the controller?

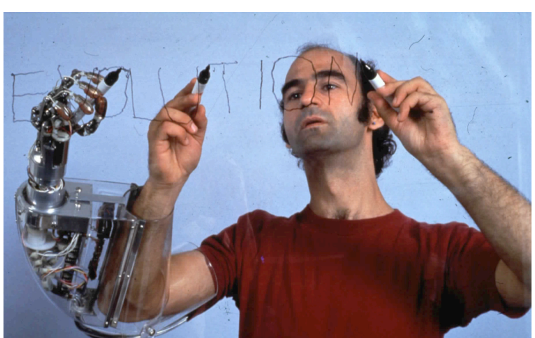
Screen capture from eXistenZ. (SNI)

From *The Wizard*'s rapt depiction of the Nintendo Power Glove to *The Matrix*'s copious use of special effects, Hollywood has always depicted cybernetics as a more responsive and powerful form of control, granting the player the ability to issue commands at the speed of thought and offering complete dominion over gaming action. Players do not merely control a representation of themselves, remotely observing the events of the game as one would regard the pieces on a chess board; rather, players *become* the representation, responding to the altered reality of the game world as if they were its natural inhabitants. In these depictions, there is no controller; there is only the player and the game. Film director David Cronenberg, known for his recurring motifs of human/machine amalgamation, provides one of the most literal interpretations of this model of interaction in his 1999 film *eXistenZ*, a highly stylized (and characteristically weird) depiction of the eponymous hit video game of the future. The game's hardwired interface consists of organic "Metaflesh gamepods", which attach to the body pseudo-umbilically; the player's physical body lies comatose while the game takes place in the player's mind, in as direct a manner as a human could fathom. A theme recurring throughout the movie is the characters' functional inability to differentiate between what is real and what is part of the game, since the game engages all of the player's perceptions in a manner indistinguishable from reality—the invisibility of any sort of interface or degree of separation between the game and the player is the cause of this confusion.

If indeed there existed a way to adapt all (or even many) of the brain's many modularized functions to produce machine-translatable output, this would produce a huge increase in game functionality, as our brain functions tremendously outnumber our appendages. Peripheral output would similarly be revolutionized, as our every sensory function could be adapted to the game environment. Though it is not theoretically impossible for these fabulous contrivances to be invented one day, such reality-altering devices are perhaps hundreds of years into the future, if we are to even realize them at all; programming a game that could adequately use even half of the brain's functions are even more distant.

There are, however, certain instances in modern science where science has succeeded at extracting controllable computer input at the neural level: in 2000, a Duke University team headed by Miguel Nicolelis adapted signals directly from an owl monkey's brain, such that certain arm movements it made were translated into computer data, which a robotic arm used to concurrently perform identical movements (BBC News Sci/Tech). However, this process was long, costly, and required not only intense statistical analyses of brain signals but also complex and invasive procedures that would be unethical to perform on human beings (hence the monkey).

Another recent study at the University of Washington at St. Louis was conducted on four adult epilepsy patients, who had electronic grids placed atop the surface of the brain. In much the same way as the Duke University experiment, the researchers correlated electrocorticographic signals emitted by the brain with the subjects' motor activity, and were ultimately able to program a video game to recognize certain neural patterns as data input; the subjects were able to control a cursor in a video game with brain signals (Fitzpatrick).



Stelarc's neuromuscular interface. (Stelarc)

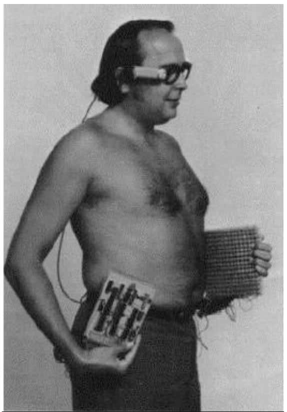
Perhaps most convincingly of all, the Australian artist Stelarc, in collaboration with a team of scientists and doctors, surgically augmented his body with a mechanical “third arm”, which he controls with nerve impules in his abdominal and leg muscles (Stelarc). Here, the device is controlled directly by the peripheral nervous system without analysis of brain impulses, and it is able to move independently of the movements of his other arms.

While these findings forcefully suggest that the enticing prospect of controlling machines with sheer force of will is within the realm of scientific possibility, the above mentioned examples are still a long way from interfacing a player’s complex procedural knowledge, memory, and emotions. Due to the great cost and dubious safety of the processes involved, direct neural interfaces are unlikely to be applied to play purposes for quite some time, and their staggering implications are deserving of their own paper. As a consequence, the rest of this section will focus primarily on non-neural “close” interfaces—“close” simply describing any interface operated with the body by way of direct contact. What this definition considers as connection to a game device is much simpler, seemingly trivial: to be “close” to a device is to be constantly near it, to have it in contact with you. As we will observe, this fact does not affect player performance so much as it affects the player’s perception of the gaming experience.

III.A.1 Perceptual and Proprioceptive Effects of Close Interaction

Wide-spread expertise in some sort of tool usage is to be expected in all human societies, and as work, leisure, art, communication, and science have all become increasingly technologically mediated for purposes of efficiency or economy, the breadth and depth of expertise has only increased. It is no surprise, then, that the most commonly used objects have been conceptualized as parts of the human body, since it is so easy to relate objects to the means of their usage. Glasses-wearers have been called “four-eyed”; in Finland, the omnipresent cellular phone is colloquially referred to as “kanny”, which translates as “extension of the hand” (Fogg 192) and Germans have been known to call it the “handy”. Beyond the scope of mere slang, though, there are instances of familiar devices feeling like or substituting for parts of the body, given a high degree of familiarity. Blind people who use canes to guide themselves around often report being able to “feel” the ground in the cane’s tip, rather than in the hand that holds the cane (Richardson); similarly, race car drivers have claimed to be able to feel the road in their tires, and frequent writers can feel the properties of the paper in the tip of their pen (ibid.). While these claims might be interpreted as hyperbolic boasting, there is ample psychological evidence to support their claims.

First of all, the phenomenon of extra-bodily sensation should not be unfamiliar to most people; for example, the condition of “phantom limb” in amputees (wherein volitional movement and sensation are keenly felt in the missing appendage) is well-documented. A second notion is that no matter where on the body a stimulus is perceived to be felt, the process of sensation occurs entirely in the brain; it is only by a function of the brain that sensation is mapped to a specific body part. Furthermore, the brain is not geared towards building an exact internal representation of the outside world, but rather it dynamically examines input, comparing it to already-known thoughts and perceptual data, “[exploring] changes in stimulation in order to guide action” (ibid.). In this sense, the brain can associate input with the physical reality of the environment, until it learns, for example, that vibrations in a cane-holding hand may be interpreted as the sensation in the



A TVSS subject. (O'Regan and Noe 958)

tip of the cane. With experience, the brain learns to render sensory input in the most organized and easily interpreted system possible, and such a system is called a *schema*.

The phenomenon of object-based schema formation is well-demonstrated by the development of the Tactile Visual Substitution System (TVSS), a device designed to translate visual information into tactile stimuli in order to give the visually-impaired a means of perceiving visual phenomena:

> A TV camera (mounted on spectacle frames) sends signals through electronic circuitry (displayed in right hand) to an array of small vibrators (left hand) which is strapped against the subject's skin. The pattern of tactile sitmulation [sic] corresponds roughly to a greatly enlarged visual image. (O'Regan and Noe 958)

The results of this experiment revealed that tactile information provided many of the same benefits as normal ocular vision, with well-trained users even dodging out of the way of rapidly approaching objects. Furthermore, although the array of vibrators on the user's back had a significant gap in the middle (to accommodate the backbone), users did not report any corresponding gap in their tactile-visual perception; rather, they perceived a unified whole. This study establishes that, through the use of devices, humans' perceptual faculties can be adapted to substitute for functions other than those for which they have seemingly evolved.

However, this still does not prove that the devices we use can actually, for all cognitive purposes, *become* parts or extensions of the body. To this end, a study by Matthew Botvinick and Jonathan Cohen sought to establish the existence of a phenomenon in which “tactile sensations are referred to an alien limb”[4] (Botvinick and Cohen 756); to establish this would mean that a person is capable of experiencing sensation in objects not typically considered a part of his/her body, a notion which would have considerable ramifications for our bases for bodily self-identification. The experiment designed to test this phenomenon was performed by Botvinick and Cohen as follows:

> Each of ten subjects was seated with their left arm resting upon a small table. A standing screen was positioned beside the arm to hide it from the subject’s view and a life-sized rubber model of a left hand and arm was placed on the table directly in front of the subject. The subject sat with eyes fixed on the artificial hand while we used two small paintbrushes to stroke the rubber hand and the subject’s hidden hand, synchronising the timing of the brushing as closely as possible. (ibid.)

Participants consistently reported feeling as though the rubber hand were their own hand; as one participant related in a free-report description, “I found myself looking at the dummy hand thinking it was actually my own” (ibid.). To emphasize the depth of this illusion, one of the experimenters, suddenly and without warning, produced a hammer and struck the rubber hand forcefully. In response, the participants protectively pulled their own hands away, as if they were the ones being struck (Richardson). This experiment demonstrated that bodily self-identification can be “externalized”, in that the brain may be perceptually fooled into believing that non-self objects are actual parts of the body.

However, it must be conceded that the effects of this experiment were produced by what the experimenters called “a three-way interaction between vision, touch and proprioception” (Botvinick and Cohen 756); that is, it was the cross-modal perception of

[4] This phenomenon should not be confused with the “alien limb effect”, an almost opposite phenomenon in which subjects feel as though one of their own body parts is not part of their body. The afflicted alien limb may perform complex actions completely independent of its owner, and the owner may not even be aware of its actions until they are pointed out to him/her.

the rubber hand being stimulated, concordant with the sensation of having one's own hand stimulated, that produced sensation in the non-self limb. This implies that the effect's required conditions and range of effects are very specific: one must have their own body out of sight; one must be able to somehow map or relate the non-self limb to one's own; both limbs must be acted on in the same way by similar stimuli; and the effect is only one of substitution, not one of augmentation. Now, while it is not impossible to have a game device that satisfies all of these constraints, this particular phenomenon does not apply to the majority of gaming models that exist today. More likely, the player will be observing the game state on a video display, separate from the input devices s/he is using to play the game. Although the video display is certainly a game output device in its own right, the majority of the meaningful content of its output is determined by the programming of the game, rather than the intrinsic properties of the device. Thus, by Botvinick and Cohen's findings, seeing a virtual hand struck onscreen and concurrently feeling a tactile kick in one's own hand (probably delivered through the gamepad) would not cause one to believe that either the monitor or the gamepad was part of one's own body, but rather the onscreen virtual hand.

By the conditions Botvinick and Cohen put forth, then, most currently existing game controllers do not extend the human body in the sense that the mind is actively tricked into believing that they are really parts of the human body. With a different sort of input modality, however, this effect might become more likely to occur. Besides the "Third Arm", Stelarc has done extensive work on what he has dubbed the "Virtual Body", which uses "a motion-capture system of electromagnetic position-orientation sensors" in order to control a virtual body on a remote display (Stelarc, "Involuntary"). Movements of the user's body prompt corresponding changes in the virtual body, but "a virtual surrogate would not merely mimic the physical body's movements" (Stelarc Home Page); rather, the user can also rotate, distort, and otherwise manipulate the virtual body, producing sensations of proprioception. Stelarc describes the perceptual relation between the physical body and the virtual one as a "complex combination of kinesthetic and kinematic choreography" (ibid.); the analogy to choreography is fitting, for it is because of the interaction between the real body and the virtual body that the perceptual effect happens. This example supports Botvinick and Cohen's findings, and establishes how the phenomenon of sensation in non-self objects can be achieved without direct neural interfacing.

III.A.2 Cognitive Effects of Close Control

A study performed by Clifford Nass demonstrates how the way that one is physically attached to an interface device influences the degree of expressiveness with which one interacts with the computer (Brave and Nass, 282). Two groups of users were made to answer questions given by a computer program about subjective, personal issues, the first group using a microphone headset physically attached to the computer by its cord, and the second group using a desk-mounted microphone array, which picked up ambient sound and did not physically contact the user. The study established that users of the microphone array gave answers that were longer and judged as more creative, and also that the participants spoke more—effects that closely match those of similarity and congruity, mentioned in the previous chapter. Nass hypothesized that the physical sense of confinement produced by the headphones was transferred into the cognitive constraint. Proximity, then, may restrict game play, which is a medium heavily dependent in many ways on a player's ability to adapt and solve problems; Sutton-Smith describes video games as "models of problems in adaptation" which "exist to simulate some adaptive problem" (64).

Another phenomenon elicited by repeated close interaction with a game device is the development of expertise. *Expertise* entails the ability to perform complex actions faster, more efficiently, and with fewer demands on cognitive resources (the limited amount of attention, awareness, conscious thought people possess at any one time) through conscious, deliberate, and repeated practice (Anderson 279). The acquisition of expertise is practically a universal human faculty, and given a high enough degree of expertise, people can perform activities with complete *automaticity*—that is, with little or no cognitive resources devoted to the task (Palmeri 5).

There are several clear benefits to developing automaticity for a certain activity, namely that cognitive resources may be dedicated to other activities, which may be performed in tandem. This is especially necessary for game device usage, since it is not an end in itself, but rather a means to perform the activities demanded by a game. However, automaticity possesses certain inherent qualities that perhaps have less obviously appealing effects. It is not a conscious or controllable phenomenon; one cannot deliberately manage it in the same way one can manipulate one's conscious thoughts and attendant actions, and as a result, the content, initiation, and cessation of automatic actions are not always under control (ibid). If an expert stenographer is told to stop in the middle of her typing, s/he will take longer than a non-expert to stop typing, and it will require an amount of attention for her to do so. This is due to a phenomenon called *clumping*, in which experts at a certain activity condense the procedures involved in the activity into discrete, indivisible cognitive "clumps" for the sake of easier mental processing (Raskin). Furthermore, automatic actions are *stereotypic* in that they are performed in more or less exactly the same fashion each time, and attempting to change the action will result in a loss of automaticity (Palmeri 5); they are also *rigid* in that they do not adapt to novel stimuli without the aid of cognitive resources (ibid.). Perhaps most importantly where close control is concerned is the fact that automatic actions are not always initiated consciously, but are obligatory and stimulus-driven—triggered by external stimuli and capable of occurring without the conscious awareness of the agent (ibid.).

While automaticity may certainly be developed without the aid of any apparatus, the obligatory and stimulus-driven nature of automatic behavior strengthen the link between automatic behavior and close control; the direct contact provides several opportunities for behavior-triggering stimuli to be transmitted to the player. By using different proprioceptive stimuli (changes in temperature, force feedback, movement, etc.), close controllers may provide direct cues that the player has no choice but to perceive. A game's audio may be muted, a game's video may be obscured, but the game may theoretically still be played; in contrast, someone using a close controller is necessarily subject to any of the output transmitted through it—tactile feedback, for instance. Even the mere sensation of interacting with a tangible interface serves as context that may promote expertise and automatic behavior; the phenomenon of state-dependent learning (Anderson 228) asserts that memory and skill retrieval are functions of how similar one's physical conditions are at the time of memory encoding. This suggests that associating a particular device and particular modes of output to a game may facilitate the acquisition of expertise. This acquisition may not be within the player's control: "No amount of training can teach a user not to develop habits when she uses an interface repeatedly. That we form habits is part of our fixed mental wiring: habit formation cannot be prevented by any act of volition" (Raskin).

Individual inputs on most current game devices are designed to be operated with a particular part of the body—the thumb operates a gamepad's buttons, the index finger works the shoulder buttons, and so on. After practicing and acquiring automaticity in a given game, one no longer has to consciously map the usage of a button to a certain onscreen function; rather, the action is unconscious to the point that it seems to the player that s/he need only "think" the action in order to perform it. The stimulus-driven nature of automatic tasks implies that if a situation requires the experienced player to jump, s/he will be able to perform the physical actions that translate into the appropriate game input; in the case of the gamepad, it would produce a controlled twitch of the thumb. What this scenario describes is the association of procedural bodily functions to a specific action, which is a common enough phenomenon in the real world: for instance, a basketball player will practice dribbling the ball until it becomes integrated into the act of moving. However, the computer input device distinguishes itself from these actions in that input techniques need not correlate in any direct way to their virtual effects. The classic perceptions of Newtonian cause-and-effect are suspended through the mediation of the controller: a slight twitch of the thumb may result in an onscreen character delivering a punch, or accelerating a car, or any number of other actions. What this creates is a sense of amplification and modulation of input, which, in addition to creating a satisfying illusion of power, can lead to body parts becoming associated with functions of an arbitrary nature. Traditionally, human body parts have been associated with a small range of functions: the eyes for seeing, the feet for walking, the hands for dexterous manipulation (the word "manipulation" deriving from *manus*—Latin for "hand"). In *Our Own Devices*, Edward Tenner argues that most human technology is created for the enhancement and augmentation of these body functions; with a computer input device, however, it is possible for parts of the body to transcend the nature of their functions, such that a single motion of one's thumb can result in locomotion, or firing bursts of energy from one's virtual body, or performing several complex actions at once.

After considering these facts about the body and how it defines itself, it is not difficult to imagine that devices we use are, for any cognitive purposes, integrated into our bodies through continued usage. This, as we have seen, may lead to a sense of having the body—literally or figuratively—augmented, transformed, and modified as its real-world activity is repurposed into virtual action. The controller, then, is the physical appendage that does the work of converting real to virtual, the cybernetic human body's extension into virtual worlds. With this idea in place, we should consider the idea that, in a similar sense, the controller is an extension of the game being played. As we mentioned in the previous chapter, controllers may serve to physically represent game elements, pulling game objects into the physical domain as it projects the player into the realm of the virtual. In this sense, the controller is not merely a gatekeeper between the physical and virtual worlds, but rather the point at which the human and computer agents converge, the physical embodiment of computer play interaction.

III.A.3 Affective Video Gaming

One should not assume that close control implies manual control. There are several ways for the human body to create viable input by measuring its various properties; this class of input is known as *affective video gaming* (Gilleade). For example, it is certainly not impossible to imagine a controller that measures one's heart rate; this could be translated into output used by the computer to measure any number of things. A physically strenuous game like *Dance Dance Revolution* might use the information to tailor the difficulty of a level in real-time, so as not to over- or under-exert the player; a game like any in the *Resident Evil* series that attempts to induce fear could respond to a player's quickened pulse in a suspenseful situation by introducing enemies to heighten the sense of fear, or by tampering with the player's controls in order to simulate the effects of panic. More advanced technology could feasibly monitor the composition of a player's breath for chemical changes, various hormones in the bloodstream (those governing stress-response come to mind first), and, in the neural-interfacing controller of tomorrow, the activity of neurons.

Jan Raposa's biometric *Asthma Busters* interface. (Raposa 78)

Indeed, many of these ideas have already been implemented to some extent: one game entitled *Breathing Space*, created by the European research group Mind Games, uses sensors attached to the body to monitor breathing rate, which in turn controls the flight of an onscreen bird (BBC News World Edition). Jan Raposa of the Ivrea Interaction Design Institute designed a similar game, *Asthma Buster*, using an oximeter and heartbeat monitor; interestingly, while the respiration of the player was used to make the player's character fire bubbles, the heartbeat sensor actually affected the movement of the enemy characters, meaning that player input impacted both player and mainframe behavior[5] (Raposa 72-3). Yet another game, *Synergy,* was designed by students at the Rensselaer Polytechnic Institute, in which one player issues commands via keyboard while the other player, hooked to heart monitors and operating a dance pad, executes the first player's commands; the cardiovascular input picked up by the heart monitor determine the force and accuracy of the in-game weaponry (Brenna 13).

The elements of biofeedback and biometrics add a new dimension to gaming, creating a sort of meta-game that requires the player to regulate and control one's real-life identity as well as their remote virtual representation, further strengthening the tangible link between the two. As we will discuss further in chapter IV, the physical disciplines involved in managing non-manual bodily parameters offer new classes of skills and activities that we may include within the definition of computer play.

III.B Technological Homogeneity

In "A Cyborg Manifesto", Donna Haraway expresses a vision of a cyborg-dominated society, in which the processing of information displaces standard modes of interaction:

[5] This, however, does not necessarily violate our notion of the mainframe as an entity acting independently from the player, since we could define heartbeat as a type of "environmental input," a notion which is explained in chapter 5.

> …the translation of the world into a problem in coding can be illustrated by looking at cybernetic (feedback-controlled) systems theories applied to telephone technology, computer design, weapons deployment, or data base construction and maintenance. In each case, solution to the key questions rests on a theory of language and control; the key operation is determining the rates, directions, and probabilities of flow of a quantity called information. The world is subdivided by boundaries differentially permeable to information. Information is just that kind of quantifiable element (unit, basis of unity) which allows universal translation, and so unhindered instrumental power... (Haraway 164)

The "unhindered instrumental power" which Haraway refers to describes one interesting consequence of enhancing the body with mass-produced technology: to the extent that people rely less on their own bodies and more on the functionality of the technology, the intrinsic differences of individual bodies disappear. In the domain of computer-mediated play this is especially salient, since one's condition within a game is determined entirely by the use of the input device. This leads to the notion that forcing players to interact through a device will dampen those individual physical differences that lead to disparities in real world games; computer input technology, then, has a potential for enabling distinctly egalitarian play interactions. Although, as Brenda Laurel might argue, the controller is by no means a culturally neutral object (in terms of design aesthetics, gender or ethnic associations, etc.), it is clear that a button on a typical gamepad does not distinguish between male and female, tall or short, weak or strong[6]; given identical input, controllers can (and usually are) configured to respond identically. This suggests that in the process of translating physical input into virtual data, computerized input devices have the ability to launder away cultural, ethnic, gender, and even physical differences. In this respect, computer mediated play has the potential to

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[6] This is not to suggest that such biased devices could not or do not exist, but rather that for whatever reason, most input devices are fairly accessible to most players.

differ greatly from unmediated play, in which physical constraints are often immutable, or at least not easily compensated for.

Physically intensive sports are the best example of this; whereas an unmediated sport must be played with respect to the physical attributes of each of the players, a controller mediated game can map a certain type of input to another, meaning that actions like running, jumping, or throwing can be performed virtually by an arbitrary input modality (button pushing, finger wiggling, heart beating, etc.). In an idealized form, this might place almost all of the emphasis of play on mental finesse, rather than physical training: a football game utilizing Vannevar Bush's hypothesized neural interface would shift the focus of the game to factors such as strategy, reflex, and manual coordination, leaving size and strength to be either determined by the mainframe or represented by other means of game input[7]. Presently, there are no practical interfaces that would effectively eliminate all physical factors from a game, but the point is that because computers have the capacity of removing or automating any number of physical handicaps, one might consider human-computer play the most potentially egalitarian form of play.

Conversely, the controller possesses an equal capacity for precluding usage by certain user demographics. As mentioned in chapter II, the two XBox controller types demonstrate that something as fundamental as physical dimensions can make a controller device difficult to use those with smaller hands; furthermore, manual input may be altogether impossible for those with limited use of their hands. The aforementioned

[7] Of course, this is not to ignore the fact that skill conditioning still plays a factor, and that some people may innately be mentally better-equipped than others to use certain controllers. Nor would I denigrate the role of bodily conditioning in play and sport; however, it is important to acknowledge that the possibility of eliminating differences in bodily size, fitness, and musculature exists, should anyone desire it.

You're In Control interface, which takes streams of urine aimed at a urinal as input, is an example of how even biological sex may be prohibitive to the intended use of certain devices. Designing a controller, then, is a problem not only of functionality and usability, but of social accessibility: one must take into full account the intended audience of the device in order to avoid inadvertently handicapping a category of players by virtue of the physical design or input modality.

III.C Philosophical Perspectives on Controller-Mediated Play

In addition to engaging the body's basic, visceral senses, the game controller can also affect the conscious and subconscious levels of human cognition—the components of the brain governing self-awareness, feelings, metaphorical thought, intellect, and reasoning. Many philosophical definitions of the human mind include these human faculties (along with memory, imagination, will, etc.), and there exist several studies on human engagement in tasks and human-computer interaction that have demonstrated the ways in which video games impinge on them. The effects of controller usage in particular are characterized by one overarching sensation: the experience of figurative mental unity with the game. From the manner in which people regard functional, manmade objects to the actual mechanics of controller usage, the presence of the controller bears directly on this conspicuous and important facet of human-computer play.

Theories of device and object interaction in the fields of sociology and philosophy often focus on the ways in which one's values and mental states both cause and reflect the way one relates to objects. Taking a Freudian perspective, Csikszentmihalyi and

Rochberg-Halton conceptualize certain manmade objects as symbolic vessels—"carriers of repressed desire" (23)—into which human drives and desires are unconsciously invested (22); in the language of psychoanalysis, this emotional investment into an object or concept is commonly known as *cathexis*. D.W. Winnicott asserts that cathexis is accompanied by "some degree (however slight) of physical involvement" (88), which is consistent with our view of the controller's conceptual function. Csikszentmihalyi and Rochberg-Halton assert that the purpose of the cathectic interaction is to resolve deep, subconscious dilemmas by giving them tangible form, so that they may be acted on:

> The most potent psychic energy is the most destructive, which must be tamed in order to become effective. The very fact that subconscious drives are allowed to express themselves consciously, even though disguised beyond recognition, is supposed to relieve the inner tension between id and superego, thereby helping the integration of personality. This transformation of the inadmissible into the harmless is the essential symbolic process in Freudian thinking. (ibid.)

As for which objects are likely to become those carriers of repressed desire: "An object whose shape, function, or name is similar to a bodily part or process that is the seat of a given desire will be unobtrusively substituted for the real thing in a person's preconscious" (23).

It seems that the controller is a prime candidate for the enactment of conscious expression upon subconscious conflict; as interactive media researcher Janet Murray notes, "working on the computer can give us uninhibited access to emotions, thoughts, and behaviors that are closed to us in real life" (99). The controller, as an instrument of play, is an object systematically manipulated for the purpose of virtual expression and control, often towards a certain well-defined goal or end, and frequently under conditions of emotional engagement. The nature of the control is inherently active and manipulative rather than passive, as each action performed on the controller results in some reaction from the game state—Csikszentmihalyi and Rochberg-Halton use the term *cultivation* to designate this process of “interpretation and self-control… motivated by goals rather than by origins” (4), and the attention expended to act on this process as “psychic energy” (ibid.). As the object through which a player performs all play acts in a video game (thereby fulfilling the goals of play), the game controller emblematizes the bodily parts and processes that are “the seat of the desire”; in effect, the controller becomes the organ of play, substituted for the body parts one might typically employ in a given play act.

As we have discussed in the previous section, one may (with some restrictions) identify the game controller as an extension of integral parts of the body; this may also apply to more reflective conceptions of the self. On the subconscious level, it would make sense for an object invested with a person’s volatile desires to both belong and not-belong to him, since it would allow him to identify with the emotions while keeping them at a sufficient distance to consider them rationally. The controller fulfills this criteria because on one hand, it dutifully receives and transmits the input that the player creates, but on the other hand, the actual process of transducing physical action to game action is beyond the player’s control and understanding.

The controller device’s meaninglessness outside of the context of a particular game (as the game is what determines its ultimate function) affords it the symbolic neutrality that, as Carl Jung argues, is necessary for emotional transfer (24). Csikszentmihalyi and Rochberg-Halton situate Jung’s argument in the context of “union”:

> A symbol is charged with psychic energy and transformative power precisely because much of its meaning is unknown or unconscious. Jung believed that unconscious drives included not only needs for physiological satisfaction but also powerful desires for personal development and spiritual union with the social and physical environment. (ibid.)

This notion of melding with a physical environment as an intrinsic human desire, as well as the notion of using a game controller toward that end, are supported by the observed qualities of the experience of computer mediated play, which are the topic of the next section.

III.D Subjective Experiences of Computer-Mediated Play

In this chapter we have addressed the idea that the controller is an extension of the player as well as a component of the mainframe, with the conclusion that the controller represents a convergence of the real world and the game world. This is not merely an empty poetic interpretation of simple device usage, for many of the subjective qualities that characterize computer gameplay suggest that the convergence is tangible and has a real impact on the overall experience.

The experience of computer gameplay is a complex amalgamation of qualities both similar to and distinct from other forms of device usage and object union, including game interaction, manmade device interaction, computer usage, and human play. To articulate the experience precisely, it should suffice to disentangle its various aspects and assess how the controller affects each one individually. What follows are descriptions of three conceptualizations of experiential phenomena which characterize the video game experience. Specifying how the game controller bears on each phenomenon in isolation should form a picture of its overall impact, an effect that constitutes a significant part of the appeal of video gaming.

III.D.1 Immersion

Janet Murray defines the term *immersion* as an experience of participatory media (and digital media in particular) in which the participant feels as though s/he is "transported to an elaborately simulated place" (98). She argues that this experience, regardless of the content of the simulation (ibid.), is pleasurable: "We enjoy the movement out of our familiar world, the feeling of alertness that comes from being in this new place, and the delight that comes from learning to move within it" (98-99). Another characteristic of the immersive experience is that it requires the participant to relinquish "all of [their] attention, [their] whole perceptual apparatus" (98). This capturing of attention is not caused only by response to events in the immersive environment, but by the demands of perceiving the "sensation of being surrounded by a completely other reality" (ibid.) and the "overflow of sensory stimulation" (99)—in other words, the mental work necessary to conceptualize the experience itself[8].

In Murray's conception, an immersive experience must be strictly delineated from the non-immersed world, so that participants can "enter the real world without disrupting it… be sure that imaginary actions will not have real results… [and] act on our fantasies without becoming paralyzed by anxiety" (103). Clearly, if anything does the job of separating the real and game worlds in our Three Agent model, it is the controller, the

[8] A study by Recarte and Nunes, in which participants were made to operate a car under normal driving conditions while engaging in different types of problem-solving thought, seems to support the notion that creating a remote immersive space demands a particularly high degree of attention. The results of the study indicated that "Tasks with high spatial imagery content produced not only more pronounced effects but also a particular pattern of long fixations" (120); in other words, the spatial nature of the tasks demanded a greater amount of attention and actively interfered with processes dealing with the "real world".

physical liaison to the game world that regulates and selectively constrains the player's actions within the game world.

Murray argues that in order to separate the two worlds, it is necessary to have an identifiable border, both spatially and psychologically. She addresses the role of current game device technology in providing the proper context for an immersive experience:

> "Screen-based electronic environments can also provide the structure of an immersive visit. Here the screen itself is a reassuring fourth wall, and the controller (mouse or joystick or dataglove) is the threshold object that takes you in and leads you out of the experience. When the controller is very closely tied to an object in the fictional world, such as a screen cursor that turns into a hand, the participant's actual movements become movements through the virtual space. This correspondence, when actual movement through real space brings corresponding movement in the fantasy world, is an important part of the fascination of simple joystick-controlled videogames." (Murray 108)

The concept of a "threshold object" is one similar to the notion presented in *III.A* of how controllers provide physical contexts for automatic action. Here, the threshold object is priming not only learned behaviors, but also the mental faculties necessary for the experience of immersion. As Murray suggests, requiring a tangible object to perform the play act structures the entire experience as a "visit", delineating the physical and temporal boundaries of the experience (when the player is using the controller, they are playing) and thereby fulfilling one of the necessities of immersion. Certain controller types capitalize further on the threshold effect by demarcating a part of the tangible real-world as a part of the game space: Namco's arcade game *Kart Duel*, for example, had users seated in a semi-realistic hydraulic cart with a steering wheel and pedal controller. This not only facilitates the process of immersion by lowering the amount of cognitive work necessary to conceptualize the immersive "other world", but heightens immediacy as well. This approach to providing immersion is even effective enough to compensate for lack of sensory detail elsewhere in a game; as the managing director of Namco

Europe claimed, "Kart Duel players will pay for the experience and not the high tech graphical content—in other words, what is the point in providing expensive, state of the art visuals when people simply want to sit in a damn kart" (qtd. in Nolan 34).

However, this is not to say that a controller will always enhance the immersive experience. If, as Murray claims, the limited amount of human attention is a resource necessary to maintain whatever experience is offered by the game, then a controller that distracts the player in a manner unrelated to game content would detract from the game's sense of immersion. Deficiencies in usability will have the most obvious impact: a player who is needlessly concentrating on the controller is not paying attention to other aspects of the game that constitute immersion: the sensory details of the simulated world and the sense of one's location within it. The controllers that do contribute to immersion are those whose explicit operation is intended as a part of the game experience: *Kart Duel* is one example of this, as the likeness to real cart racing is essential to the game's premise, and in games like *Dance Dance Revolution* and *Para Para Paradise*, the player's coordination of body movements on the controller is an end in itself.

Barring those with serious design flaws, however, computer devices seem to lend themselves to immersive experiences, even those that are not intrinsically intuitive. The keyboard is a good example of this: despite the fact that it takes a fair amount of training to learn, at a certain point, the computer can "seem like an extension of our own consciousness, capturing our words through the keyboard and displaying them on the screen as fast as we can think them" (99). This also agrees well with our notion of automaticity, and conveys the notion that the input device, far from necessarily acting like a barrier between the user and the computer environment, may rather seem like a natural component of the consciousness with which one communicates automatically with the computer.

III.D.2 Immediacy

Immediacy and *hypermediacy* are contrasting terms used by media researchers Jay David Bolter and Richard Grusin to distinguish between two different ways of presenting media. Immediate media are presented in a way that diminishes as much as possible any semblance that what the medium is representing is distinct from the object of its representation. In computer game terms, an example of this might be Konami's *Silent Hill 3*, which, with its high level of graphical realism and lack of onscreen status displays, gives few indications that the game is fictional or that the events depicted are not actually happening. This style of presentation has also been dubbed *transparency*, since it attempts to render the medium invisible and intangible, allowing the observer an unadulterated experience of the object of representation. It must be noted that for most current media, the effect of immediacy is necessarily incomplete; however, "the logic of transparent immediacy does not necessarily commit the viewer to an utterly naive or magical conviction that the representation is the same thing as what it represents" (Bolter and Grusin 30). Hypermediacy, as you might expect, is the opposite of immediacy, as it "acknowledges multiple acts of representation and makes them

Screen capture of *Silent Hill 3*. Note the lack of onscreen status display. (contactmusic.com)

visible" (Bolter and Grusin 33-34); in other words, it makes the user aware of the fact that what the user is observing is a representation of a thing, rather than any specific thing itself. Games such as *Dance Dance Revolution*, with its abstract onscreen informational displays and frequent acknowledgement of the player, fit into this category.

By definition, the subjective experience of immediacy is the feeling of having nothing between oneself and what is being presented by the media. This notion is similar to that of direct manipulation (discussed in chapter II.A), in which the participant experiences "directness" and "engagement" with the objects that are being represented, whether computer data files, virtual objects, or onscreen characters. It would seem that the presence of a game controller is anathema to any sort of immediacy, and in an objective sense, this is true: interacting with a device in order to manipulate the imperceptible computer data that represent a game state is about as indirect as one could imagine.

Screen capture of *Dance Dance Revolution Extreme*. The display consists almost exclusively of abstract information. (keepgaming.com)

However, as we have noted in the previous section, human perception is far from objective, and as a consequence, the game controller is capable of both maintaining a game's transparency or completely destroying it. Of course, neither immediacy nor its opposite is fundamentally preferable, as there are successful games of both types; however, the presence of immediacy has an impact on the game experience which may be beneficial or detrimental depending on the nature of the game.

The measure of how much a game controller impacts a game's immediacy is the extent to which it draws attention to the game medium. Where computer play is concerned, the usage of a game device is itself indicative of mediation between game and player, and so it might seem that devices visible by or in direct contact with the player would lessen immersion by serving as a constant reminder. However, one might argue that certain such controllers—like the light gun, which is always in the player's field of view—actually heighten the sense of immediacy by turning the game controller into a game element. Whereas a first-person shooter game merely represents the player's gun on the bottom of the screen, a light gun game eliminates that aspect of representation by making the gun the controller, rather than using a controller to control an onscreen gun.

Hasbro's *Simon*, which represents game objects physically. (Booth)

Therefore, the controllers that call attention to themselves should theoretically only detract from a game's immediacy when they do not mimic or substitute for an element that would otherwise be virtually represented by the game. Typically, this is a trait associated with abstract design, which leads to the general conclusion that tangible, abstract controllers are more likely to make a game feel hypermediated.

However, this is not even the case in all instances. The practice of physically representing game elements with the controller, regardless of their abstractness, may make a game immediate in a simpler sense; rather than attempting to obscure the gap between the player's physical world and a remote virtual one, it can be used instead to express the entire game physically, literally removing all barriers of spatial location. In most computer games today, game worlds are represented by blinking dots of colored light on computer or television monitors, a form of representation that is easily identified as separate from the objects of representation. In this form, it is easy to understand why many people would instinctively distinguish between what is virtual and what is not, since the onscreen elements are strictly separate from games in the real world. However, in certain games, the physical representation may be all that we see of the game: computer-controlled games like *Whack-a-Mole*, *Bop-It*, and *Simon*, for example, represent all objects in the game state physically, although all other elements of the game are managed electronically. By physically representing computer games in their totality, the controller essentially reverts the computer gaming process back into one that more closely resembles non-mediated object play, while still benefiting from the advantages of computer mediation (transduction of physical action into data, complex response, etc.). Direct interaction with the physical elements of the game becomes the entire basis of the game, rather than indirect interaction on elements in a remote game state.

III.D.3. Flow[9]

We have established that interaction with and immersion in most computer games demands intense concentration, which inevitably lowers the amount of attention normally devoted to cognitive processes. Consequently, the key "symptoms" of gameplay are characterized by the dampening of subconscious behaviors: the subjective experiencing of self-consciousness, reality, and time are to an extent suspended, resulting in a hyper-

[9] The description of the "flow experience" that follows is paraphrased from Csikszentmihalyi's *Flow: The Psychology of Optimal Experience*, unless noted otherwise.

attentive, goal-oriented state of mind. As it turns out, this phenomena is described by the psychologist Mihaly Csikszentmihalyi's theory of optimal experience, or "flow", briefly mentioned above. *Flow* is a subjective experiential phenomenon characterized by a sensation of selectively heightened awareness, control over one's situation and destiny, propulsive and continuous cognitive activity, and paradoxically, effortlessness. The experience is intense, pleasurable, euphoric, and potentially addictive, and can arise from tasks of any nature, whether physical, contemplative, or sensory. The conditions under which flow occurs are quite specific, requiring activities with particular qualities and participants with certain mindsets. Flow is a topic of special interest to play researchers because so many games seem to fall under the purview of flow activities; HCI researchers have also applied principles of flow to the design of compelling user interfaces.

The following is a list of the characteristics of *flow activities* as defined by Csikszentmihalyi, as well as the various ways that the presence of the controller influences each one in the act of computer mediated play:

-<u>Telicity and clear feedback</u>. Flow activities must have one or more explicit and attainable goals, and must provide adequate feedback that keeps players informed of their progress towards those goals. Csikszentmihalyi contends that the presence of a challenging goal and the satisfaction of receiving positive feedback (or the fear of negative feedback) are the incentives for focusing the necessary amount of concentration onto the particular task in the first place, and for maintaining concentration when encountering setbacks and frustration. The primary importance of goals and feedback, then, is that they constitute the basic structure of the activity; without them, the participant cannot order his/her consciousness enough to know if what s/he is doing is correct, or if s/he is any closer to achieving the goal.

Certain types of game controllers may aid in the definition of task structure by constraining the amount of possible actions that may be taken at a given time. Suppose a player is using a gamepad with only two buttons; even if s/he is unsure of how to proceed in the game, s/he will know that those two buttons are the basis of everything that is possible within the game. Compare this to giving a child a set of jacks and a rubber ball: though the child may find equally creative and entertaining uses for them, the objects do not afford the specific structured play activity for which they were created. Constraining user input to a limited range of actions is one of Jakob Nielsen's usability heuristics as described in II.A, but in this case, the purpose is not to prevent the user from committing errors in their action, but to tangibly inform or remind users of the full range of options available to them. This allows players to structure their actions in terms of what they know is possible, instead of leaving them to determine the correct course of action through trial and error and straying from the goal solutions that the designer may have intended the player to use. Of course, this only applies to game interfaces that utilize objective, unambiguous input of a certain nature: it must be understood that a particular input will map directly to single action. If the input modality is voice, or example, then the controller is less helpful for structuring action, since it may suggest many more actions (singing, talking, mimicking, yelling), each with their own standards of evaluation (do I sing on key, or try to get the lyrics right?). In contrast, a button can only be used in one way: by pushing it. If pushing it does not produce positive results, then it was simply not the right action to be performed at the time, and the player may construe this fact as semantic feedback.

-<u>Distinction from ordinary reality</u>. This characteristic overlaps with Murray's immersive visit, in that both experiences distort the boundaries of what Csikszentmihalyi calls the "'paramount reality' of everyday life" (72). This distortion can be achieved in numerous ways: direct tampering with the perceptive faculties; the imposition of arbitrary rules, such as the rules of sports or artistic composition; the introduction of random elements, as in games of chance; and, perhaps most relevant to the immediate discussion, the creation of alternative realities, as in "dance, theater, and the arts in general" (ibid.). Each of these elements may induce the flow experience by providing the illusion of transgressing different aspects of "paramount reality": respectively, the rules of perception, one's typical priorities, physical causality, and one's identity and environment. It is a safe bet to say that all or a huge majority of video games may be characterized by one or more of these four elements; the activities that Csikszentmihalyi characterizes as distinct from ordinary reality are "Play, art, pageantry, ritual, and sports" (ibid.), categories which can be said to encompass most genres of video gaming.

Immersive experiences are the distinction provided by video gaming experiences, and as Murray illustrated above, the controller, as a threshold object, plays a role in reinforcing the separateness of gameplay from non-gameplay. The knowledge that all one's actions will be mediated through a device provides the player with a different set of expectations of how to act in a game, as opposed to real life, where there are an arbitrary number of ways to act within one's environment.

-Appropriate difficulty. An activity that is far too difficult breeds frustration, defeatism, or anxiety; an excessively easy activity causes boredom and trivializes the significance of progress in the activity. In either case, inappropriate difficulty diminishes or destroys the pleasure that the flow state purports to generate, making the activities meaningless and no longer intrinsically motivated.

From a game design perspective, the programming and settings of a computer game and the player's capacity to respond to the challenges that arise should primarily determine its degree of difficulty; the controller, it is assumed, is a constant. However, the specifics of input techniques often heavily affect how well one is able to perform game tasks, an axiom of usability. Some people may choose to modulate the difficulty of the games they play by intentionally using devices not suited for the games they play—stories circulate among the gaming community about people completing the fighting game *Soul Calibur* with the Sega Fishing Rod (EGM), thus exhibiting a different kind of mastery over the game—one that may certainly be satisfying by merit of its intrinsic challenge, but perhaps also for other reasons, which will be discussed in the next chapter.

-Giving the participant control. One aspect of the flow experience that clearly relates to the subject of controllers is the importance of the perception of user control in a flow activity. Csikszentmihalyi includes physical sports and games in this category, as well as interpretive and creative activities like art, performance, and reading. Control in a flow activity is part of what makes it satisfying, as the participant knows that any positive outcomes are the direct result of his/her own skill and intervention. Any feature of the design and usage of the controller that influences the player's sense of control (whether ethopoetic bias or perceptual trick) pertains directly to a video game's suitability as a flow activity. For instance, the cultural and social effects on a player's regard towards the controller, as well as the perception that the actions performed on the controller directly affect the onscreen action, are salient factors; the feeling of amplifying input and extending one's capabilities is another.

The relation between the controllability of a game and the structured nature of a flow activity is apparent:

> …many gamers are drawn to the degree of control that the digital world offers. Why spend time in the real world, with its random events, unpredictable outcomes, and breakable rules when you can interact with a place that is constant and logical, where actions always have an equal and opposite reaction? When one is playing Super Mario Brothers, one knows that jumping on an opponent's head will defeat it. The same jump on the same enemy will always produce the same outcome… Game rules stand in stark contrast to the rules of the real world, where we are surrounded by unpredictability and uncertainty at all times. Even the simplest actions in life exhibit a degree of perceived randomness. (Maguire)

To be able to predict the exact consequences of one's actions greatly contributes to one's ability to formulate the necessary steps to achieve a certain goal. Because many controller archetypes constrain the player into using distinct inputs with rigidly defined functions in the context of a game, a player using such a controller can be confident that the solution to any problem in a game can technically be found with the right combination of inputs. For example, consider a game in which the specific tasks to be executed are left unspecified, for whatever reason; as we discussed above (in "Distinction from ordinary reality"), elements of randomness are common to flow activities. However, in-game randomness can be supplied primarily by the content of the game. By contrast, the typically stable and unchanging structure of the game controller provides a way for the player to deal with random occurrences in a familiar way. As we discussed in chapter II, the controller "[provides] users with a familiar orienting device and [helps] them learn and understand how to use the system" (Preece et al., 56).

A good example of how a controller's constancy can help order and systematize in-game randomness is the Game Boy Advance game *WarioWare, Inc.: Mega Microgame$*, which consists of a fast-paced battery of minigames that requires players to learn and execute commands in under 5 seconds per minigame. The very unpredictability of each task is what makes the game exciting, as the player must recognize and execute such abstruse actions as petting a dog, brushing a set of teeth, or extinguishing a fire. What makes the game accessible and fair, however, is that every action is performed either by pressing the A button or moving the D-pad. Since the player understands this simple fact as owing to the unchanging nature of the controller, s/he does not have to worry about having to perform the "random" activities in any correspondingly random way.

However, it should be noted that the certainty that a controller provides may be on the decline for some controller paradigms:

> We now see that the complexity of games is slowly approaching that of the physical world. The actions a player can take to achieve a goal are becoming less formulaic and less predictable. This is clearly manifested in modern game control devices. In the past, games were controlled with simple on/off buttons – a limited set of digital inputs… Contemporary games make extensive use of analog input devices. These analog devices are capable of detecting hundreds of degrees of precision. Examples of analog control devices include the mouse, the trackball, and the analog joystick. These devices are able to communicate a much finer degree of user input.
>
> The advent of these hypersensitive control conveyances and ultra-detailed game worlds have [sic] triggered a backlash… "Retro gamers" view modern games as an intrusion, as their games have traditionally been perfect little playgrounds with simple and obvious rules. Now, the feeling of randomness and uncontrollability characteristic of reality is seeping into their game worlds. To them, escaping into modern game worlds is like trading one dystopia for another. (Maguire)

So we see the converse argument: controllers without these constraints (such as those that we will be discussed in later chapters) must take into consideration their potential for ambiguity, lest they make gameplay inappropriately complex.

III.E Liminality

What the characteristics of the experience of computer play described in this chapter have in common is not their causes or preconditions, but a sense of merging, of obliterating all boundaries (distractions, mediations, distances) and becoming truly engaged with the content of the medium. The phenomenon of immersion is a clear example of this, as it describes the freeing of one's cognitive processes from the boundaries of the real world, while keeping a distinct delineation between game and player. Immediacy is the disappearance of the player/game barrier, which is to a large degree regulated by the modality of the controller's inputs. Furthermore, Csikszentmihalyi describes flow as "merging of action and awareness" (53), and the state in which people "stop being aware of themselves as separate from the actions they are performing" (ibid.).

In this section, I will simply introduce a term coined by the anthropologist Victor Turner, one that will perhaps serve to capture all of the notions described thus far in this chapter. *Liminality*, whose etymological root stems from the Latin word for "border", describes a state of "between-ness", or of exclusively belonging neither to one category nor its opposite. This concept subsumes many different aspects, some of which have been discussed in the preceding sections: Jung's state of symbolic union exemplifies liminality in the social sense, much as sensation in non-self limbs is a physically liminal experience. Though Turner conceived of liminality specifically for the purpose of describing and accounting for social rituals, he defined this term to be applicable to a wide range of phenomena; in the coarsest sense, a liminal experience is characterized by the "liberation of human capacities of cognition, affect, volition, creativity, etc. from… normative constraints" (Turner 44). The non-social aspects of this phenomenon have been represented in the language of cognitive and behavioral psychology, philosophy, media studies, and HCI, to describe other circumstances under which people arrive at boundaries of sensation and identity.

The controller's crucial role in providing liminal experiences is somewhat ironic, since, by direct proportion to how well it integrates effectively with the player, the controller has a hand in its own disappearance. Inadvertently, this might justify the absence of the game controller in Hollywood depictions of immersive game experiences: in the future, the controller may not actually disappear, but it might seem to.

So liminality expresses the experience of symbiosis described by the various aspects discussed in this chapter. We have considered how using devices for the purpose of play impacts one's expressiveness, perception of physical boundaries, spatial awareness, and relation to the computer. In his speculative writings in the 1960's about future technology, eminent media theorist Marshall McLuhan pinpoints what is perhaps the deeper significance of the collision of player, controller, and mainframe:

> The hybrid or the meeting of two media is a moment of truth and revelation from which new form is born… The moment of the meeting of media is a moment of freedom and release from the ordinary trance and numbness imposed by them on our senses. (McLuhan 55)

The hybridity of computer-mediated play is not merely the collision of two disparate fields; it is a new form altogether, one with qualities and possibilities absent from both unmediated play and general computer interaction, an experience in which the programming of the mainframe, the senses and knowledge of the player, and the parameters of the controller are only the beginning.

IV. Appropriation and Adaptation

> *But techniques do not create themselves, and neither operators nor their supervisors initially understand the full possibilities of devices.*
> —Edward Tenner, Our Own Devices (7)

While the game controller has the capacity to precisely replicate the physical properties of existing objects and devices, it may also transcend physical properties through its ability to transduce any quantifiable data into any virtual action; As Donna Haraway put it, “Information is just that kind of quantifiable element... which allows universal translation” (Haraway 164). Indeed, one of the defining characteristics of the controller is how it manages the user’s relation to virtual objects and actions by selectively providing and withholding access to and control over various input parameters, as determined by the mainframe’s specific programming. It follows from the principles outlined in previous chapters that the functional design aspects of a controller—from its shape and size to the spacing and placement of inputs—have discernable effects on how games are played. These effects can themselves be consciously adapted by both game designers and players to transform the qualitative gameplay experience.

In this chapter, I will define and consider two complementary notions in controller design and usage: appropriation and adaptation. *Appropriation* refers to *a player’s deliberate modification of the properties of an input device with the intent of altering gameplay*. *Adaptation* refers to *the process by which design aspects of the controller encourage or necessitate player activity that transcends play in some significant way*. These two concepts are related by the notion of the controller’s presence in some way allowing for transgression of the computer gaming medium, with the player entity being the impetus for appropriation, and the mainframe (and by extension, the game designer) responsible for adaptation. Both phenomena provide ways of modifying the game experience without affecting the actual game state itself. This chapter will examine how these relationships to technological mediation distinguish human-computer play from play acts in the real world.

IV.A Player Appropriation of Controllers

As we have noted, controllers can transform any sort of measurable input into raw, quantifiable data, which can be interpreted without any regard to the method of input. If the computer receives data input that it can interpret as a "jump" command, it does not care whether that command was issued by a gamepad, a light gun, or any other type of input device. As a consequence, computer devices are transposable to the extent that a single game may be played by any number of devices; a virtual action can be physically realized in any number of ways. This fact distinguishes computer-mediated play sharply from non-mediated play by allowing a particular task to be performed in a nearly arbitrary number of different ways by substituting the device used for a certain game.

For the sake of counterargument, I will concede that it is possible to use, for instance, a badminton racket or baseball bat or any other object instead of a tennis racket when playing a game of tennis, in order to achieve the effect of transposing game elements in order to alter the play experience. However, the game controller differs in many respects, the most dramatic being its ability to map input to output regardless of modality. Using a controller, a "jump" command might be executed in an arbitrary number of ways—flashes of light, real-life jumping, a hand gesture, a verbal command—whereas in real life, one is typically confined to a smaller range of means to physically execute a certain command. An incoming tennis ball cannot practically be returned with a beam of light or a hand gesture, whereas in a video game this is perfectly feasible. Furthermore, a particular controller's input mappings are not necessarily bound to a particular function, and several games provide players with the option to reconfigure settings to their whim.

Having established the uniqueness of controller mediation with regards to mutability of configuration and transposability, we can now identify various ways in which players appropriate controller devices in order to subvert and transgress the gameplay experience.

IV.A.1 Reconfiguration of Key Bindings

The practice of reconfiguring the mapping of controller input to game action has traditionally been common in computer games using keyboard input; for console-based gamepads, it came into fashion with the advent of the fairly complex multi-key controllers of the 16-bit console generation. Key reconfiguration has nothing to do with directly modifying the controller's physical constitution; rather, it acts on the programming of the mainframe. However, it is the very existence of an object whose functions may be redefined that, by definition, makes key reconfiguration possible in the first place.

The most obvious purpose of reconfiguration is to allow players to suit key bindings to personal preferences, which is in itself a non-trivial distinction from (and arguably, an advantage over) non-mediated play. These preferences typically follow the principles of usability and functionality as discussed in chapter II: users will most often choose key bindings that are familiar, comfortable, and standard, while more advanced players may experiment with bindings that help them perform complex moves in a shorter amount of time or with fewer key presses.

The necessity of this flexibility varies with the complexity and task structure of the game; certain genres of games, by their nature, emphasize effective key configuration more than others. One genre in particular has historically given a great deal of control over key configurations—the fighting game. The emphasis on customizable controls is based not only on the quick maneuvering and reflex-response demanded by many genres, but also the preponderance of complex, ordered button and directional input sequences used to perform more powerful moves. This is where the ability to control how inputs are arranged relative to one another becomes crucial to one's success in the game.

Consider this sequence of inputs from the game *Tekken 5*, which is typical of many combinations in 3-D fighting games: "Leg Stretch Arm Lock = LP RP RK LK LP+RP+LK" (Vagts). Not only does this combination use each of the four attack buttons in the game, it also incorporates one input where three buttons must be pressed simultaneously. In the arcade version of the game, pressing the three buttons simultaneously is not difficult because the four buttons are fairly large and each button can be controlled by separate fingers. However, in the PlayStation 2 console port of the game, it becomes more difficult, because the four default buttons assigned to each of the attack buttons are small, close together, and all operated with the right thumb. Pressing three buttons simultaneously with just the thumb is quite difficult, and repositioning your hand in order to use other fingers is not only awkward given the shape of the controller, but also restricts access to the top shoulder buttons. Fortunately, key reconfiguration provides an elegant solution to this problem: in *Tekken 5*, as in many fighting games, a single button input can be mapped to several outputs, meaning that the controller can be configured to execute "LP+RP+LK" at one button press. Here, finally, we see the utility of having redundant or "extra" inputs on a controller: they can be designated not only for single functions in more complex games, but also combinations of buttons in games like *Tekken*. The plurality of functions that may be assigned arbitrarily to any input is yet another feature of computer-mediated play that is simply not possible in non-mediated play.

Building on the notion of technological egalitarianism presented in chapter III, reconfiguration not only allows players to tailor their play style to whatever configuration of inputs suits them best, but also to overcome physical handicaps that may accompany a default configuration. However, introducing the possibility of many different input methods, even for controllers that are identical, raises the question of whether or not key reconfiguration can constitute an unfair advantage. This is mostly a concern for competitive gaming, in which equal footing in controls is required for fairness. But which is more "fair": to have all players compete with the same set of key bindings, or to allow players to configure their own controls, thus allowing for the possibility that some players may have inherently "better" controls than others? Interestingly, the answer for most modern competitive gaming leagues seems to be the latter. Both the Cyberathlete

Professional League and the World Cyber Games have a policy of allowing players to set their own key bindings (“ The Cyberathlete…”); the CPL has implemented a graphical user interface toward that end (Welch), while the WCG allows its competitors to bring their own controllers (World Cyber Games). From this we can surmise that the players’ skill in formulating an optimal key configuration is considered—at least by certain professional gamers—to be a valid aspect of gameplay.

Although it does not count as player appropriation *per se*, it is worth mentioning here that it is also possible for controller input mappings to be altered by the mainframe, rather than the player. While this is not a common occurrence, there are many cases in which doing so is entirely appropriate; it can be a very effective way to reflect something about the state of one’s in-game character. For example, in Square-Enix’s *Secret of Mana*, when one’s character is afflicted with “confusion”, the directional key bindings are temporarily reversed, such that pressing “up” makes the character move down, “left” moves right, et cetera. In many games (*Time Killers*, *The Legend of Zelda*) it is possible to have one’s character selectively damaged, such that certain functions are rendered unusable; it is easy to represent this simply by disabling whichever button corresponds to that function. The mutability of the bindings provides yet another way for computer-mediated play to transcend properties which, in the real world, would be fixed.

IV.A.2 Device Customization

Though altering the key bindings is the most common form of appropriation, there are many instances of players modifying or customizing their controllers toward functional, aesthetic, or simply exploratory ends.

Particularly in the arena of competitive gaming, improving one's performance is a premium for which many players will spare no expense. It would seem that some element of modification exists for most competitive genres; two currently popular and very different competitive games—*Dance Dance Revolution* and the first-person shooter *Counter-Strike*—are good examples of common controller modifications.

<u>*Dance Dance Revolution*</u>. On the Internet and nationwide, *Dance Dance Revolution* players have formed a large community around the game and all of the elements of gameplay. Equipment modification is a topic of great community interest, for several reasons. Because directions appear on the screen at high speeds and in occasionally awkward combinations, the game demands a high amount of coordination and precision, and so ensuring an optimal setup is a concern to many players. A common complaint made of many plastic dance pads was their tendency to slip under the intensity of gameplay motions, making it difficult for players to re-center themselves and position themselves relative to the screen. In response, fan websites began to recommend various do-it-yourself methods of keeping the board steady, ranging from simply taping or weighing it down to the floor, to more enterprising modifications as attaching it to a large piece of

A custom-built DDR dance pad. (Wu)

wood, or fashioning one from scratch out of metal and electronics (Wu). Furthermore, since the game demands intense activity, the pad sustains a great deal of wear and tear, prompting players to write how-to guides on reinforcing wires and adjusting the foam inserts.

These pragmatic modifications forecasted a fan-initiated slew of tweaks to the dance pad's sensitivity, sturdiness, texture, weight, and comfort. For some players, dance pad modification became excursions in home engineering, as people have either adapted or made from scratch their own customized dance pads from plexiglass, wood, steel, foam, and whatever else construction required. At least one fan convention has held workshops on dance pad modification (Lum), and many message boards (DDR Freak) and fansites (Wu) that have sprung up around the topic have flourished.

Counter-Strike. As the modifications players make to their dance pads usually tend to focus on enhancing its overall efficacy as an input device, they seem to strive towards a certain singular ideal embodied by Konami's proprietary arcade machines, which have a high sensitivity, durability, and weightiness, not to mention a support bar. However, the open-ended goals and strategies available to players in other types of games makes controller customization correspondingly less straightforward; for instance, *Counter-Strike*, another popular game that has engendered a large competitive player base, has seen forms of hardware modification among its players that are somewhat divergent, even if they serve the same general purpose of improving performance. Even relative to most games in the notoriously twitchy first-person shooter genre, *Counter-Strike* demands a high level of key coordination in the management of weapons, movement, aiming, and communication. As a result, players have been known to pry keys out of their general purpose keyboards (especially the infamous "Windows Start" key, which agonizingly minimizes the game screen when pressed) in order to reduce the chances of accidentally hitting the wrong keys when inputting commands in quick succession (PanchoDaz). This is a good example of redesign for usability, where simplifying the device comes at the cost of the range of function.

Despite that functional modifications are the most common type of controller reconfiguration, many players modify their game devices for aesthetic purposes, as the above picture of the custom metal DDR pad might suggest. Recalling Csikszentmihalyi's concept of "cultivation", the game controller represents an object into which personal attention and energy is devoted by many hardcore players, so it follows that those players would want its appearance to reflect the nature of that interaction. It is not surprising, then, that among video gaming's hardcore devotees, the controller is the regular object of expressive customization. That the NES controller has already itself become marketed as retro-kitsch attire (see above) would seem to support the feasibility that a controller might serve this aesthetic function. The aesthetic expressions that may be embodied in a controller are effectively limitless, ranging from stylized cultural references (as in the dance pad shown above), to whimsical gaming in-jokes, to extravagant fashion statements. To understand the breadth of this sort of modification, compare the first controller—a proprietary Dreamcast gamepad—to those below it, all of which are actually modified versions of it:

The NES Controller belt buckle. (NESBuckle.com)

The standard Dreamcast controller
(blue version). (Amazon.com)

Various modifications to the standard Dreamcast controller. (Devcast)

More Dreamcast controller modifications.

This sort of controller adaptation obviously falls outside of any sort of functional purpose, though there are certainly reasons to believe that such modifications might have a connection to one's performance in a game. Obviously, any changes to the shape or functionality of the controller in the process of aesthetic modification will affect its usage—the Dreamcast gamepad that uses the NES gamepad's casing would only be useful for the Dreamcast games using four or fewer buttons. Also, the aesthetic modifications need not be visual; for example, though it constitutes a much greater engineering challenge, the practice of modifying the tactile feedback capabilities of a controller is not unheard of (Rose). Then there are ethopoetic factors to consider, such as Donald Norman's "attractive things work better" thesis and Clifford Nass's findings about the effects of similarity and familiarity on proficiency of usage. Replicating a specific gaming experience is another motivation for controller modification, which also accounts for the effort put into making teleologically ideal NES controller mockups, arcade-style metal dance pads, or arcade MAME cabinets—a costly and labor-intensive endeavor, in some cases.

It seems inevitable that the gaming hardware industry will capitalize further on the trend of aesthetic controller modification once it becomes more widespread. Many previous attempts have been unsuccessful and inconsequential—Dynasound Organizer's oft-derided "Power Grips", unwieldy plastic blocks intended to make the NES controller more comfortable to hold, serve as grim testament to the mostly unambitious and ham-fisted attempts at marketing controller modification thus far. There have been a few obscure-but-worthy ideas—Saitek's P120 controller, a generic gamepad intended for use with the PC, comes packaged with a small thumb-operated joystick shaft, which may be inserted into a hole in the directional pad. This cleverly provides the player with the practical choice of standard directional-cross input or joystick input, through a simple modification. Logitech's "Lap Attachment for Force Feedback Wheels" controller add-on provides players a way to stabilize driving their steering wheel controllers in their laps.

The Saitek P120 PC controller. (Saitek Electronics Directory)

What this might indicate for controller design in the future is a shift towards modularity. Rather than designing general-purpose controllers that attempt to support a wide range of games—as is currently practiced—we might begin to see controllers with few or no intrinsic base functions, but with the capacity to accept many different combinations of inputs, to be chosen and configured by the player according to specific game or genre preferences. A

A MAME cabinet replica. (ArcadeControls.com and Maida)

hardcore RPG fan might choose to only purchase and use the few attachments necessary for movement and menu navigation; a sports game fan might create a setup with a large analog joystick that emphasized ease and precision of movement; other gamers might eschew mechanical input entirely for a single microphone attachment, allowing them to play those games that supported vocal input. It is easy to see how this model of control would emerge out of the increasing delineation of genre in gaming, along with recognition of the game controller as a crucial, emblematic component of the gaming experience.

Despite that controller modifications are currently of little consequence in the game industry, adornments and do-it-yourself modality-switching customization kits for one's controller in gaming and electronics stores will probably be a matter of course. An excellent example of device modification is Ideazon's zBoard series of gaming keyboards,

Clockwise from top-right: the World of Warcraft keyset, the FPS keyset, and the bare zBoard base. (zBoard.com)

first introduced in 2000[10]. The zBoard consists of a base and one of any number of custom keysets, which attach over the base. In addition to the generic "gaming" keyset, whose functions can be entirely customized by the user, zBoard offers keysets which are designed with specific games in mind: the First Person Shooter keyset, for example, has the WASD keys enlarged and the usual action keys surrounding them in an accessible spatial configuration. Other keysets geared towards games like *Everquest* and *World of Warcraft* are designed with a similar specificity, with labeled special function keys. A software "Game Binding Utility" allows the user to reconfigure key bindings at will. The zBoard removes most of the player involvement in manually rewiring and tinkering with the hardware, instead providing players with the option of choosing among pre-optimized keysets which can be used with the base. Here, the base resembles the modular controller discussed above; the Game Binding Utility clearly acknowledges the importance of control over keybindings; and the keysets, colorfully designed to match the aesthetics of whichever game they correspond to, embody both aesthetic and functional modification. If the zBoard is any indication of a trend, then the multimodal, infinitely configurable controller should not be far off.

IV.A.3 Transposing Input Methods

The capacity for transposing inputs while leaving game action unchanged, which I have described above as one of the game device's distinguishing characteristics, is currently a feature seldom exploited by most console games—players have been much

[10] The features of the zBoard in this paragraph are based on the specifications on the website, zBoard.com.

more industrious towards this end, adapting controllers intended for one type or genre of game for their own transgressive purposes.

One such form of appropriation sees the controller playing a role in an obscure sort of bragging-rights challenge: players use specialized, genre-specific controllers for games other than those for which they were designed. These types of usages tend to be informal and done for the sake of novelty, so it is difficult to find documentation on any organized or "official" instances (i.e. tournaments, events, clubs, etc.); however, perusal of online message board discussions reveals that they are quite common. Dance pads have notoriously been the favorite input device for such activities; take, for example, these empirical reports of its use in non-rhythm games:

> --I like the DDR controller. Ever tried that for a fighting game? Whoo! ("Controllers")
>
> --i beat some kids at street fighter using a ddr pad lol… god i have no life lol
> --I tried Gran Tourismo 3 using a soft pad, sit in the center, feet on X and O's, and using my hands to steer.
> --i played GT3 with a dance pad. I put the leg of the chair down to hold the X button to accellerate ("ddr pad for other games")
>
> --I played Street Fighter. I was even pulling off specials. I somehow won a round.
> -- My friends and I used to play Soul Calibur II against each other on the dance pads... that was damned amusing and rather exhausting actually... lots of jumping, especially when the sides switched, and furious stamping to get in grabs... it was insane.
> --I tried playing Madden. It was impossible. ("Has anyone…")

This sort of play has frequently applied to other peripherals, such as arcade joysticks and the Nintendo Power Glove; however, the dance pad seems to be the most popular choice for transposition. There seem to be two likely reasons for this; the first is simply a matter of the dance pad's buttons doubling as the most commonly used buttons on a standard gamepad. This notion might seem counterintuitive to some, for why would one transpose a gamepad with a device whose inputs share the same input modality, when one supposed objective of transposition is to get a much different experience of the game? The answer is that to transpose inputs for a game across modalities, the programming of the game must fix some rigid mapping from the inputs of one device to those of another. For example, in order to use a light gun for a game that ordinarily uses a gamepad, the software of the game would have to be programmed to recognize the light gun input, to fix the light gun input to game actions, and to ensure that the light gun modality is even capable of executing all of the actions necessary to play through the game. Since, as I mentioned before, game designers typically do not account for (or care about) their game's ability to recognize any but the suggested input devices, they would clearly not spend valuable development time and labor implementing these features for every conceivable device on the platform. There is, however, one notable and fairly well-known exception, conveyed here by an aficionado of the Dreamcast version of the fighting game *Soul Calibur*; in this excerpt of his review of the game, the author waxes enthusiastic about the many, varied, and obscure extra features:

> …It is moves like these, not earth-shattering but quite eye-catching and interesting, that lay the foundations for more innovative uses of modern gaming hardware, if nothing else. And, last but not least – practically the most unusual of extras found in any fighting game, ever – is the use of Sega's "fishing rod" peripheral in conjuction (sic) with Soul Calibur…if the player connects this special controller in one of the joypad ports and [starts] it using the attached buttons, the game recognizes it and, should the player move on to the battle itself, the unthinkable happens! By moving the rod controller in all directions, the player can in fact move the weapon of the character [selected], be it one with a sword or any of the other hand-held weapons. Of course, the peripheral is not able to trace the movement of the player – this means that, in order to sidestep, one still has to use the D-Pad on the rod. But waving the fishing controller this way and that does move swords, rod and axe, letting the player block and attack flawlessly after some practice. Special moves are out of the question, of course… but regular moves are quite easy to execute, even for amateurs of the game." (Farkonas)

There is at least one game, then, that accommodates a form of unlikely cross-modal (yet oddly intuitive) transposition of input, but this is clearly an exception of standard industry practice. Those controllers that mimic the input of the accepted standard input devices will most likely be the most popular candidates for controller transposition, which explains the dance pad's popularity. Its straightforward, rigid mapping of directional and button inputs to those of the gamepad allow its input to be accepted by any game that uses a gamepad.

The second likely reason for the dance pad's popularity is that the challenge of using one's feet to perform game actions that are designed for the more agile thumb-and-gamepad setup is both difficult and a basis for bragging rights even when players can only claim a slight measure of success. For some players, developing the finesse to merely play the game normally given such handicaps has become an active pursuit; in Japan, one man responded to a popular gaming magazine's "Improbable Gaming Accomplishments" contest by submitting a video of himself completing *Soul Calibur* on its hardest difficulty setting using only the motion sensing input of the Sega Fishing Rod (EGM 108). The quotes above also reflect the added appeal of the logistical challenges that the new controller devices pose; determining the best way to adapt the controller to the specific tasks of the game is cited as an important part of the experience, as people used chair legs to hold down buttons, or sat down in order to use all of their limbs, and so on. Thus, the difficult-yet-feasible challenges of regular game play using a transposed device constitute a flow activity, where the tasks are well-defined (simply playing the game), the challenges are adaptive (working with the deliberately awkward control scheme), and the results are satisfying[11].

The Dreamcast Fishing Rod controller device. (Alerigi)

[11] Though the distraction of concentrating on the device usage, rather than the game, might actually detract from the appeal of the game content itself.

Another thing to note about the efficacy of transposition is that the similarity of numbers or types of inputs between the two controllers has an impact on the extent to which the two may be effectively transposed. For example, most PlayStation2 dance pads cannot be used successfully with many PS2 games, since they lack many of the PS2 Dual Shock 2 controller's functions.

A phenomenon related to transposing controllers is the practice of playing a game with multiple input devices; usually, one achieves this by playing a multiplayer game and assuming the roles of 2 or more of the players by oneself. This is somewhat distinct from simply using two devices to play the single player mode of a game—for example, a steering wheel and a pedal—but only in the sense that in the case of the steering wheel and pedal, the game was designed for that purpose. Like controller transposition, assuming the roles of two players is clearly a more complex task than normal gameplay for the same game, and for that reason, it shares much of the same appeal as transposition. Alongside other feats of video game mastery, one website boasts movie files of players who have completed games by controlling both players simultaneously ("Arc's Movies…")—these range from older games such as *Rush 'N' Attack* to newer ones like *Ikaruga*[12].

The *Dance Dance Revolution* games have successfully exploited the usage of two inputs by a single player by implementing a "Double mode", a slightly modified version of the single-player game, specifically designed to be played feasibly by a single player. This indulgence of the player on behalf of the game designers seems to take some of the

[12] The video footage of *Ikaruga* is particularly impressive, as the player not only plays the game capably, but takes advantage of his ability to coordinate both spacecraft to synchronize his attacks and use them to cover the other, thereby playing *more* effectively than two players acting individually.

transgressive thrill out of the appropriation of multiple controllers, but appeals to many players nonetheless; one fan gives these reasons for the greater appeal of this method of input:

> 1. It requires more skill visually. With eight arrows instead of four, you have a lot more information to process at once, and things can get quite hectic. Single will seem easy to see after playing a lot of maniac double songs.
> 2. It requires more stamina, and burns more calories. Simple physics fact: By accelerating and deceleration (sic) your center of mass, you do a lot of work, ad (sic) thus burn energy. Double requires far more center of mass motion then single play (which when played well requires very little), and thus burns more calories. This translates directly into a higher required stamina level, as anyone who's played the long versions in 5th mix on double maniac knows all too well.
> 3. It allows more interesting step patterns. By having twice as many arrows to deal with, the step patterns for double are far more varied then (sic) single, and are less repetitive.
> 4. It is more flexible with performance play. Since you have a lot more room in which to move around, you can do more neat moves. (Pinansky)

Again, we see the intrinsic challenge and complexity of the control scheme cited as the main appeal of using the wrong controllers. It would seem that there are many fewer cases of controller transposition for the purposes of more effective gameplay; as mentioned in II.A, although it is theoretically easier and less strenuous to play *Dance Dance Revolution* with a gamepad, this is rarely done when dance pads are available. In other cases, the controller that is designed specifically for the game is typically the best tool for the job, for obvious reasons; the main function of transposition, then, is to provide a transgressive and alternate challenge to the act of gameplay, one absent from the realm of non-mediated play.

IV.A.4 Subverting the Intended Usage of the Controller

Another form of appropriation involves altering one's own physical relationship to the controller in order to exploit its physical or mechanical properties, for a range of reasons. One example of this sort of usage is well-known to enthusiasts of arcade-based light gun games: since many light gun games have players reload ammunition by firing outside of the boundaries of the screen, some players cover the light sensor on the tip of the gun barrel with two fingers to achieve the same effect (Valenzuela); doing so allows them to maintain their aim on the screen and reload more efficiently. This method takes advantage of the light gun's specific mechanics in relation to the game, and also ideally demonstrates Edward Tenner's principle of co-evolution between technology and its uses.

Just as a single player can use several input devices at once, multiple players may also use a single device. This might entail several players participating in a game or particular game mode designed for only one player, which has a number of ramifications. On a fundamental level, multiple players participating in a single player gaming event brings in the element of mass participation, which qualitatively impacts the experience of the game; for instance, if multiple players decide to simultaneously use a single dance pad in *Dance Dance Revolution*, the elements of cooperation and group coordination become part of the experience. This also has the natural consequence of impacting the difficulty of game tasks that are tailored to an individual player: multiple players might clearly make a task easier—for example, two people participating in an arcade arm-wrestling game or grip tester instead of only one of them. Alternatively, it might complicate the game, as the *Dance Dance Revolution* example makes clear to any group of people who have tried to coordinate their movements on the higher difficulty settings; here, as in a three-legged race, the lack of a central executive coordinator adversely impacts game performance. Another form of mass participation consists of turn-taking, for the purposes of allowing everyone to participate in the game experience, or toward more strategic ends, such as pooling the talents of a group of players in order to optimize the performance in a single game. Finally, there are some instances of device modification that require many players to use many devices in order to create a single game action: the “2 to 1 Controller Modification” described by one fansite makes single-player NES games playable with multiple controllers by requiring all players to execute identical actions simultaneously in order to perform game actions (NESplayer.com).

Beyond taking out the challenge that might make a game satisfying to play in the first place, a natural consequence of the possibility of several players operating a single controller to make a game easier is the potential for cheating. In informal settings, this might not matter much if the players involved are complicit and wish to derive their entertainment from the challenges or pleasures of cooperation; however, the possibility of illegal player cooperation has become a real and valid concern to the administrators of online gaming competitions. Due to the anonymous and remote nature of online play, it is difficult to confirm that only a single player is issuing all of the commands that are observable by the moderators of the tournament. In a recent controversial case, two high-profile competitors in online *Warcraft III* tournaments (the “Warcraft III Masters” and the “InCup”) were accused of collaborating to gain a competitive edge; a message posted to an online discussion forum around the controversy reveals the sort of judgments made to determine cheating:

> But the question remains: how do you know he was cheating?
> …Sweet was playing under the name "Silvernoma." He is an Undead player, but in recent InCup and WC3M games he has (selectively) played Night Elf. The chances of him being able to switch to Night Elf, apparently cold turkey, and win, are very low… Among all the usual forum dross, the most well-considered argument came from [Sweet’s opponent] Grubby himself, who gave several reasons he thought that it was not Sweet playing:
> 1. Silvernoma's hotkey use as Night Elf was very different from his hotkey use as Undead. For example, he hotkeyed buildings as Night Elf, even though he never does as Undead. Coincidentally, his Night Elf hotkey setup was exactly the same as Showtime's.

> 2. Silvernoma's Actions Per Minute are different as Night Elf and Undead, but are actually higher as Night Elf (his "off" race). Again, coincidentally, his Night Elf APM is very similar to Showtime's.
> 3. Silvernoma's chatting in his Night Elf games was very unlike Sweet's usual, and had some characteristics very similar to Showtime's. (madadh)

The above reasons were ultimately as the basis for penalizing Silvernoma, which is interesting because as pieces of evidence, they are all speculative and circumstantial; none of them prove definitely that he cheated. The fact that the game controller allowed for the possibility of two players to assume the same role in the middle of a competition without any way to differentiate the two except by means of empirical speculation makes the technologically mediated online competition far different in this respect from traditional non-mediated athletic competition.

There is one more physical relationship to the controller I will consider here as a form of appropriation: that which is represented by operation of the controller by a player whose body, in some salient way, functions differently than what the controller's designers accounted for. On some basic level, hardware designers must make fundamental assumptions about the physical capabilities of the user: a standard gamepad presupposes two hands and a certain amount of fingers, a microphone assumes that the player can make the right kinds of noises, and so on. Despite some notable attempts to make gaming more accessible, on the level of mass marketing, these assumptions have often failed, precluding a well-defined segment of the population from using certain controllers effectively. However, the intrepid nature of many gamers being as it is, some players have discovered ways to modify their body techniques (and their bodies themselves) to use the controller in ways other than which the designer had intended, which by our definition constitutes appropriation.

An amateur video circulating on the Internet shows a man with a missing leg walk onto a *Dance Dance Revolution* machine with a pair of crutches; he begins the game, although instead of putting his crutches aside, he plays by using the crutches and his leg to hit the appropriate buttons on the pad (ebaumsworld.com). Whether or not the video is legitimate, it serves an illustrative purpose: it demonstrates how devices can be operated with the aid of other devices in order to compensate for one's own body, or even to gain an advantage over those for whom the devices are designed. Another example is the *You're In Control* interface mentioned earlier, which is clearly intended for male users; as the picture to the left illustrates, even gender differences can be rectified with the aid of the proper device.

A third notable example concerns an incident in which the demands of a game elicited controller usage of that was not originally anticipated by the controller's designers. Nintendo's *Mario Party* often prompts players to rotate the analog joystick clockwise or counterclockwise as quickly as possible, to mimic such activities as paddling a boat, reeling a fishing line, and so on. While this is clever, adaptive function mapping on *Mario Party*'s behalf, there were unexpected ramifications of this design choice: players quickly realized that they achieved better results by whirling the joystick with their open palm rather than with their thumb, as the controller was designed (Feigenbaum). Consequently, a string of "blisters, cuts, and abrasions" resulted from the intensity of the rotating action and aggravated by the ridged plastic surface of the joystick's top (ConsumerReports.org). To rectify the matter and assuage

The *You're In Control* interface. (Maynes-Aminzade and Raffle)

the growing number of complaints, Nintendo announced the offer of a "free protective glove …that [a] child can wear to prevent injury" (ibid.), thus providing players with safer means of appropriating their controllers with their techniques.

This example illustrates that appropriation can have consequences unforeseen to both the user and the designer of a controller. In the next section, however, we will examine the ways in which controllers, in conjunction with the mainframe's programming, can be deliberately designed to elicit behaviors that extend beyond the scope of what we have identified as play.

IV.B Designer Adaptation of Controllers

In keeping with the definition I established at the beginning of this chapter, here I will define an *adaptive* design aspect as one that causes a player, as a consequence of using the device properly, to perform some well-defined non-play activity. Adaptation in its many forms is most clearly embodied by such games as *Dance Dance Revolution*, which in addition to the basic exchange of inputs and outputs between player and mainframe, encourages the player to dance, an activity which can also be construed as exercise, performance, skill training, and so on. Adaptive activities certainly need not be considered mutually exclusive to or separate from the play act, for in many cases they constitute part of the play experience—the dancing in *Dance Dance Revolution* is not necessarily separate from the play activity, but rather, the dance is part of the play. Through adaptation, not only is the player's relationship to a particular game transformed, but his/her relationship to the notion of computer-mediated play itself.

This section defines and identifies a few general types of adaptation, illustrating each with examples and describing how these adaptive activities, human-computer interaction, and play all bear on one another to yet again distinguish the experience of computer-mediated play from that of non-mediated play.

IV.B.1 Educational Adaptation.

Perhaps because of the enticing prospect of harnessing a medium that appeals so notoriously to youth, educational video games have endured as a genre in their own right. Commercially available games teach users how to type, do taxes, and any number of other practical skills; outside of the commercial sector, they have been used in clinical environments for purposes such as the treatment of phobias (Fogg 73-4). These programs compare favorably to traditional methods of learning for their respective domains; researchers in the field of interactive learning credit this efficacy to the safety and absence of adverse consequences in the virtual environment, as well as the opportunity to build personal confidence for a task or situation (ibid.). As usual, however, the programmed content and onscreen interfaces of educational software have overshadowed the role of the input device in video game-mediated learning. This focus wrongly ignores how the player's modes of physical interaction with the game provide opportunities for types of learning beyond the quality of interacting within a virtual environment.

Computer programs have been demonstrably adept at teaching tasks based on "use of metacognition and mental models, improved strategic thinking and insight, better psychomotor skills, and development of analytical and spatial skills, iconic skills, visual selective attention, computer skills, etc" (Mitchell and Savill-Smith 20). Furthermore, developing expertise in certain games "is linked to 'expert' behaviours such as self-monitoring, pattern recognition, problem recognition and problem solving at a deep level, principled decision-making, qualitative thinking and superior short-term and long-term memory" (ibid.). However, without an appropriate input device, they are limited in their capacity to convey other kinds of educational experiences, such as physical tasks and learning based on certain situations.

Below is a brief list of different types of education afforded by the usage of input devices, with examples:

Technological Habituation. What the game controller most clearly teaches in the course of its usage is how to use game controllers; given the similarity of many instances of controller types (gamepads, joysticks, dance pads, etc.), transferal of ability from one controller of a certain type to another is expected. This has ramifications beyond merely the domain of games, however; Brenda Laurel cites the use of computer devices in play as a way—especially for children—to "develop a lot of comfort and facility with the technology" (Cannes). Furthermore, since many general computing devices are used as game controllers, building one's skills with a device in the context of a game will contribute to one's overall familiarity with the device; an obvious example would be the keyboard, especially in relation to games (*Mario Teaches Typing, Typing of the Dead*) that teach typing skills. The educational component of these games is eliminated if the input device being used does not correspond to the sort of keyboard with which the user is seeking to gain expertise.

Adaptive object simulation. In II.A, we discussed how the extent to which controllers relate to play action affects how gameplay is perceived; specifically, we considered how realism and mimicry of real-world objects in controller design can make gameplay easier, more familiar, and more immersive. Because educational content can be a component of gameplay, these qualities influence the ways in which things are learned from games, as well as the type of actions that a game is capable of teaching. The design of the controller is what determines the basic physical actions a player must perform to interact with a game, and it is in this respect that controllers contribute to the medium's educational potential. The idea is that the requirement of a controller device, in combination with the tasks demanded by the game, naturally fosters familiarity with and mastery of the device and its usage techniques. This concept is by no means new in the realm of device usage; Gustav Becker, the inventor of a training piano called the "Manumoneon", designed to provide more resistance than a regular piano would, described the purpose of his invention:

> The fingers of the performer are compelled to make the desired motion in a perfect manner, and thus by attentive and continued practice, as per special direction, the student cannot help learning soon to make the movement of his own volition. (qtd. in Tenner 169)

Where the controller device differs from such devices is in its capacity to dissociate from its output. Controller input can be adapted by a game in order to influence feedback, for various purposes: for example, the game could purposefully exaggerate input that corresponds to "good behavior" in terms of the task at hand to reward the player for performing correct actions. The result is something that may be described as *adaptive object simulation*: a simulation of device usage that benefits from the properties of input manipulation and an arbitrary number of interaction modalities. As Fogg puts it, “Computer technologies that simulate objects can be powerfully persuasive because they fit into the context of a person’s everyday life, they are less dependent on imagination or suspension of disbelief, and they make clear the likely impact of certain attitudes or behaviors” (Fogg 77).

Biofeedback. Affective videogaming, which we discussed in chapter III, introduces further educational possibilities into the domain of play by virtue of its elements of biofeedback and biometrics. Games like *Breathing Space* and *Asthma Busters* have already been developed to educate asthma sufferers about proper diaphragmatic breathing; other games, such as those developed by Dublin’s MindGames research group, reward players for controlling their heart rate (e.g. *Bio-melodics*), stress level (e.g. *Relax to Win*), and stillness (e.g. *Still Life*) (Media Lab Europe). In each of these cases, the controller’s input modality obliges the player to adopt physical procedures that result in the learning and mastery of physical techniques.

***Baby Think It Over*. (Horizon Solutions)**

Experience Simulation. On the topic of involving physical interfaces in educational games and simulators, Fogg writes: “Computer technologies that simulate objects can be powerfully persuasive because they fit into the context of a person’s everyday life, they are less dependent on imagination or suspension of disbelief, and they make clear the likely impact of certain attitudes or behaviors” (77). He provides two examples of devices that have been designed for educational purposes; the first, called *Baby Think It Over*, is a lifelike baby doll designed to educate its users about the experience of teen motherhood:

> An internal computer simulates an infant crying at realistic, random intervals 24 hours a day. Intervals can be adjusted from 15 minutes to 6 hours for a normal, cranky, or particularly easy to care for baby.
>
> The "parent" is given a non-transferable key attached to a hospital bracelet on his or her wrist that must be inserted in the Baby for a specific length of time to simulate feeding, bathing, diaper-changing and comforting. Care sessions last from 5 to 35 minutes. If the "baby" has been properly cared for, it will coo to signal the end of the session. If it is neglected (allowed to cry for more than one minute) or handled roughly (dropped, thrown or struck), tamper-proof indicators on the computer will alert the instructor. (Horizon Solutions)

As we see here, there are two salient inputs: the hospital bracelet and the impact sensors. The key must be held in place by the user, which forces him/her to maintain close and attentive physical contact with the doll for the duration of the care session; the presence of the impact sensors force the user to handle the doll with caution, as one would with a real baby. Moreover, the very appearance of the device is intended to arouse sympathy on behalf of the user. The case studies evaluating the usage of this device suggest that it is effective in its aim of educating users on teen pregnancy: schools using *Baby Think It Over* have reported 50% decreases in the rate of teen pregnancy (ibid.), and 95% of the teens in one study reported that "they felt they were not yet ready to accept the responsibility of parenting" (Fogg 79).

The interior of the *Neon Drunk Driving Simulator*. (Machrone)

The second example Fogg provides, the *Neon Drunk Driving Simulator*, is a modified Dodge Neon which, when "drunk mode" is activated, "responds sluggishly and unpredictably to a driver's inputs" (ibid.). Users are prompted to navigate an obstacle course in a safe area, first without and then with the modification activated. A case study on the device found that users reported a change in their perception of drunk driving as a result of participating (Fogg 81). A similar project by Edutainment Inc. simply titled *Drunk Driving Simulator* has participants seated in a facsimile of a car with a dashboard and a 225-degree monitor display; by distorting the player's input, it attempts to simulate the effects of intoxicated driving (SaveALifeTour.net). In both simulators, the presence of technological mediation allows the system to deform input in order to produce the intended effect of disorientation and uncoordinated driving.

Device simulations often have numerous practical benefits over their real-world equivalents; "Simulation games enable engagement in learning activities otherwise too costly to resource or too dangerous, difficult or impractical to implement in the classroom… [or] hard to accomplish by other means" (Mitchell and Savill-Smith 20). However, a major and valid concern about the appropriateness of using simulations to educate is that, due to their inevitable deviation from real-life circumstances, the behavior may be "mislearned"; this applies especially to simulations like *Drunk Driving Simulator*, which omits many of the aspects of an actual drunk driving experience: realistic motion feedback, perfect graphical fidelity, the emotional effects of alcohol, et cetera. Because one learns to use the simulated device under vastly different circumstances than one might encounter using the actual device, the simulation may ultimately do little to educate the user. A simulation might even be detrimental if it leaves out important details beyond the simple usage of the device: it is one thing to

An exhibition of the *Drunk Driving Simulator*. (SaveALife.net)

know how to aim and fire a gun, but quite another to know how to deal with the consequences of firing it at the wrong things. However, these shortcomings are mostly the fault of insufficient or incomplete game output, and cannot necessarily be attributed to the input device. In the cases above, the methods of input succeed fairly admirably in their goal of making the user behave in ways that compel him/her to think and learn about different tasks.

A final note about the use of controllers for educational purposes: we should not assume that the use of game devices can educate people solely in their similarity to existing objects. The familiarity of video game devices to citizens of industrialized nations has itself impacted the way that people use other devices. Edward Tenner notes that, with the introduction of computers and handheld electronics, there has been a cultural shift in device usage techniques from the dominance of the index finger to that of the thumb:

> In Japan today, there are so many new data entry devices that young people are called oyayubi sedai, the Thumb Generation... By 2002, there were over 1.4 billion [text messages] each month in the United Kingdom alone. One British researcher, Sadie Plant, has found that thumbs all around the world are becoming stronger and more skillful. Some young Japanese are now even pointing and ringing doorbells with them. (Tenner 266)

Given the overwhelming popularity of video games in nations such as Japan and the UK, it is likely that this phenomenon has come about at least in part as a result of the frequent usage of thumb-operated gamepads. Lest this assessment of the impact of gamepad usage seem like idle speculation, there are many examples in which game usage has been linked to learning. In April 2004, a study at New York's Beth Israel Medical Center revealed that "Doctors who spent at least three hours per week playing video games made about 37 percent fewer mistakes in laparoscopic surgery" and were 27 percent faster than doctors who didn't play video games (Dobnik)—referring to standard home console games, not surgical simulators. Video games and education researcher Kurt Squire said of this finding that “with a video game, you can definitely develop timing and a sense of touch, as well as a very intuitive feel for manipulating devices” (qtd in Dobnik). As if surgery weren’t a serious enough matter, a recent SF Weekly article describes the proceedings of the “Serious Games summit” at the 2005 Game Developers Conference:

> …dressed neatly in a blazer and slacks, [US Army Scientist and STRICOM Director Dr. Michael Macedonia] runs through a PowerPoint presentation and talks about the gamer generation coming of age in the military.
>
> “The Marines are kicking back in Fallujah playing their Xboxes,” he says, putting up a slide of a control interface for a missile system. Ten young soldiers helped design the interface, which looks exactly like a PlayStation controller. “It's a continuum of virtuality,” Macedonia says. (O’Brien)

Clearly, Macedonia believes that the “gamer generation”’s familiarity with the gamepad is strong enough to entrust the design of a missile system interface to—it is difficult to imagine a device for which precision, ease of use, and learnability are more critical. Again, however, we see how mislearning the usage of a device could have disastrous consequences: if one is accustomed to using a PlayStation controller to reflexively, instinctively destroy objects in a virtual world, who can say how they might be operated in the real world?

IV.B.2 Exertive Adaptation

To some extent, all non-neural input devices require some use of the body to operate the controller. Traditionally in game design the emphasis on the body has either been downplayed in order to facilitate concentration on onscreen game content, or adapted to make the player's physical actions mimic their game actions. Regardless, some degree of physical exertion is an inevitable consequence of most device usage. Exertive adaptation describes those cases in which the design of the controller enforces a certain intensity, type, quantity, or pattern of physical exertion, such that the nature of the usage of one's body is a central point of the play experience.

Emphasis on use of the body occurs naturally in games that require the user to simulate physically strenuous activity. Once again, *Dance Dance Revolution* naturally comes to mind, and has in recent years gained much of its notoriety in the US as a means of losing weight. Scores of articles in newspapers, magazines (print and televised), and video gaming periodicals have reported on the game's ability to motivate fitness and athleticism in its player base; these articles typically tend to call attention to the young, video-game playing demographic and the extent of weight loss for regular players. One such article offers two quotes that reflect common perceptions of players who become acquainted with the game:

> "At first I was playing it for fun, but when you see results you're like, 'Yeah!'" said Matt Keene, a 19-year-old from Charleston, S.C., who used to weigh more than 350 pounds and wear pants with a 48-inch waist.
>
> Also aided by better eating habits, the 6-foot-5 Keene explained in a phone interview he had dropped to about 200 pounds.
>
> […]
>
> The game was designed to be fun. But "what the creators knew is that this is a physical game no matter how you dice it," said Enos, who says he has lost 30 pounds playing DDR. "At some level there's going to be people who want to focus on that element of the game for their own physical health or for exercise." (McNew)

These quotes exemplify the separation of adaptive activity from the core "play" activity. The first player relates how, beyond "playing it for fun", players become aware of the exertive effects of the game, while the second represents one reason why adaptive activities can become central parts of the game experience.

Whether or not the designers' original intent was to promote exercise and fitness, Konami exploited this popular adaptive facet of the game with spin-off games such as *Aerobics Revolution* and *Diet Channel*, as well as built-in "Workout" modes in the *Dance Dance Revolution* game, which tally calories that the player is supposedly burning with each input. The range of games and game modes that fulfill this practice obscure a simple fact: it is the adaptive function of the input device—and *not* the programming of the mainframe—that constitutes the exertive quality of the game.

This fact has not gone unnoticed by proprietors of third-party controller devices. RedOctane, a gaming hardware company best known for their third-party dance pads, concentrated a large part of their marketing strategy around promoting the exertive benefits of *Dance Dance Revolution*. One of their websites, "Getupmove", features testimonials by players who claim to have lost weight, advice for structuring and performing DDR workout regimens, and the aforementioned news articles in praise of the game (Getupmove.com); RedOctane has also notably donated dance pads and other equipment to public schools, who have incorporated the game into their physical education programs (Kreimer 17).

Powergrid's *kiloWatt*. (Powergrid)

Another company, Powergrid, has designed a device they have dubbed "kiloWatt", which essentially consists of a platform, a tensile metal rod, and a button array. Compatible with all of the major game consoles, the device simply replicates the functionality of a standard gamepad, implementing the analog directional controls with the metal rod, which must be strenuously pushed in order to register as game input. The

Powergrid website attributes the exertive qualities of the kiloWatt to its input modality, which is isometric (i.e. force-based) rather than isotonic (i.e. movement-based). While this attribution is not untrue, it misleadingly implies that the analog controls of console gamepads are *not* isometric—they are, of course. The actual difference is merely one of degree of force: where exertion is concerned, the only essential difference between the analog joystick and the kiloWatt rod is that the kiloWatt is harder to manipulate. Thus, while it provides no new functionality, the kiloWatt's value lies in its forcing the player to use significantly more force than s/he would otherwise, adding an exertive aspect to any console game it is being used to play[13].

There have been several (in some cases, ongoing) academic studies focusing on the specific effects of adapting computer-mediated play to a form of exercise. Dr. Richard Adler of the University of Tennessee, an exercise advocate and proponent of *Dance Dance Revolution*, is currently conducting a six-month study of 70 obese girls, aged 12 to 14. Half of the girls will play *Dance Dance Revolution* regularly and keep a record of their activity, and the other half will not play, instead watching their diet and increasing their exercise in whatever way they see fit (Kreimer); the latter group is intended to represent "the standard prescription physicians give to people who are overweight" (ibid.). This study is intended specifically to determine the efficacy of video games as a means of exercise and weight-loss; though the above anecdotal evidence seems intuitively compelling, this study tests the hypothesis more rigorously. Toward the

[13] While its website's testosterone-soaked ad copy ("Not only will you get fit using the Kilowatt, but you're going to school the guy (or gal) using a standard gamepad. Without a doubt, Kilowatt is the most precise, accurate and well built video game controller in existence") may exaggerate its utility, at anywhere from $799-$1199, the Kilowatt certainly has the distinction of being one of the most *expensive* controllers available.

same end, another series of studies is currently being conducted by Dr. Sophia Yen, a nutrition and obesity consultant to the University of California at San Francisco, who will measure the insulin and glucose levels of boys and girls aged 10 to 18.

Dr. Adler’s hypothesis is based on the observation that "Just like the kids are addicted to regular video games where they use their hands and thumbs, they just don't want to stop" (ibid.); in other words, the “addictive” qualities of video games make them prime candidates for maintaining a steady exercise regimen. While this reasoning is valid, it seems equally likely that the benefit that video gaming brings to exercise is the flow state induced by gameplay, such as that mentioned in III.B; research conducted by Dr. Costas Karageorghis, a sports psychologist at Brunei University, seems to support this argument. One of his studies establishes that video gaming induces a flow state that is at least somewhat comparable to that of strenuous athletics (Russell), while another study suggests that the flow state induced by concentration on stimuli can reduce the perceived intensity of exercise (Crust). It would not be unreasonable to conclude, then, that a video game’s beneficial impact on exercise habits may be attributable to its role as a flow activity; however, this will remain an untested hypothesis until a more focused study is conducted.

Another study, “The Inherent Appeal of Physically Controlled Peripherals”, examines player preferences in the usage of different exertive controllers. Participants played two games (the snowboarding game *SSX* and the shooting game *Time Crisis 2*) using both standard controllers and “physical controllers” (what we in this paper would call “exertive controllers”). The results supported a number of interesting hypotheses: inexperienced game players tend to prefer to physical controllers (Johnson et al. 4); the light gun was preferred for *Time Crisis 2*, but only females preferred the snowboard controller for *SSX* (6); and the degree to which the operation of the controller realistically simulated the in-game action directly correlated with the controller's usability (ibid.). Perhaps most interesting is the finding that despite the *SSX* snowboard controller had "a lack of ease of control, the absence of an intuitive interface, [and] a lack of realism" (5), the users still reported enjoyability; Johnson et. al. speculate that this suggests "a novelty value that in some ways counterbalances the less appealing features of the snowboard".

There are a few confounding factors which should be considered in this study. Johnson et al. define "physical controllers" simply as "game controllers that require the user to interact using physical movements (other than finger movements)" (10); in other words, object simulators. Consequently, although they list exercise as a benefit of physical controllers, they include a number of controllers which are not significantly more strenuous than the standard gamepad—the *Breathing Space* interface, for example. Therefore, the appeal of those types of "physically controllers" may not stem from the exertive quality of the devices, but rather their usable/realistic design. However, it must be conceded that most "physical controllers" do indeed require more exertion and macro-movement than the gamepad, so Johnson et al.'s findings should not necessarily be discounted.

Despite its appeal as an enjoyable form of exercise, the introduction of physical exertion into game interaction limits gameplay in ways that we have previously mentioned. The element of egalitarianism is diminished, and performance in the unmediated game becomes as much (or possibly more) about the player's physique as real-world athletics, to the extent that certain players may not be capable of playing in the intended manner at all. Furthermore, there is the danger that the appeal of the device might distract players into overexertion; one recent case found a teenage girl with a pre-existing heart condition undergoing cardiac arrest during a session of *Dance Dance Revolution*. The common perception of video games as harmless and sedentary, as well as the tendency to overlook the demands of specific modes of input, may belie the actual physical demands of a game.

Besides education and exertion, there are many other ways that devices can be designed to elicit different kinds of behaviors from players. With object simulation in general, experiences need not necessarily be construed as informative or educational. For example, *Baby Think It Over* is not simply a learning experience; being forced to carefully hold and attend to a lifelike baby provides a certain kind of social experience beyond its educational value.

For many players of *Dance Dance Revolution*, the intensity of the movements is only half of the appeal; the pattern and coordination of agile movements is in itself a performative act, such that in many cases it is as interesting to watch the player interact with the controller as it is to watch the onscreen action. Naturally, some controllers are more intrinsically appealing to watch than others; the class of usable/realistic devices are probably the most interesting to observe, mostly because they simulate action that would otherwise be only onscreen.

Currently, the nature of adaptation is largely physical, “tricking” the player into performing some other activity by requiring a certain bodily interaction with the device. However, with the possibility of a neural interface, the limit to what may be achieved by means of input may essentially be defined by human imagination. Along the same lines as the biofeedback mechanisms mentioned earlier, games might require players to activate different areas of their brains, with the result of even creating emotional responses from the user as a byproduct of the interaction. As controllers become more varied and more accessible, the range of adaptive activities will increase, and what it means to play will become all the richer.

V. The World as Input/The World as Controller

The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.
—Mark Weiser, "The Computer for the 21st Century"

So far we have focused on the notion of computer-mediated play as a relationship between three discrete entities: player, controller, and mainframe. These three entities are what I consider necessary to call a play act "computer-mediated", but that is not to say that no other factors may be involved; rather, gameplay can be endogenous. In order to recognize the full capacities of the game device, one must take into account the fact that they can be consciously designed to accept non-player input; in other words, depending on the nature of input, a player's environmental circumstances may significantly impact how the player is able to use a game device. Certain types of computer interaction even stretch the boundaries of the Three Agent model, introducing cases in which an identifiable controller device hardly even exists. With the introduction of these new technologies and computing models come new gaming genres, as well as evolutions of existing game archetypes.

Whereas a large part of this paper has focused on the sort of controller mediation that can be characterized as interaction exclusively between a player and a device, this chapter focuses specifically on the use of the player's physical reality as a type of input or game parameter. We will see how introducing reality into a game experience provides many opportunities for various types of immersion, player transgression, and input hybridization distinct from those in preceding chapters. These factors give rise to new styles and models of computer gaming which may indicate future trends in gameplay;

these trends will be introduced and discussed over the course of this chapter. Perhaps most significantly, using elements of the real world in a computer-mediated game creates the potential for confounding many of our familiar distinctions between game world and real world, between player and mainframe, and ultimately, between mediated play and non-mediated play.

V.A Environmental Input[14]

The concept of *environmental input* is defined here as *input which is produced by one's surroundings or physical reality, over which the player has effectively limited control*. Freeing the range of game inputs from the constraints of what the human body can produce significantly expands the possibilities for controller design and gameplay. It is already clear how we are able to implement such input devices, as we possess the mechanical means to measure environmental stimuli and quantify them into game data: thermometers quantify temperature, clocks measure time, and so on with air pressure, movement, orientation, et cetera. Like most design aspects, the impact that environmental input may have on any specific game varies; it might be as subtle and pragmatic as monitoring the level of light in the room in order to adjust the brightness of the onscreen display, or as central to the gameplay as serving as the only means of player input.

Perhaps due to their cartridge-based format and their portability, the Game Boy series of handheld consoles have supported many games that use environmental and

[14] In some sense, all games can be influenced by the conditions in which they are played—it is perfectly reasonable to imagine that a gust of wind or a falling hailstone could trigger unwarranted game input—but this section will focus instead on instances intentional of environmental input, if just to keep things from becoming absurd.

situational parameters. *Kirby's Tilt 'n' Tumble* for the Game Boy Color features a tilt sensor built into the game cartridge which takes the orientation of the console as its input, such that moving the character is intuitively the same as maneuvering a ball around on a wooden board by tilting the board. The movement is analog, in that the degree of tilt correlates directly to the speed and direction of movement. Tilting is the main form of interaction within the game, such that the Game Boy Color's built-in controls are barely used. For this game, despite the fact that the player is still in control of all of the action and is the sole participant in gameplay, it is more difficult to say that the environment is as irrelevant to game input as it is for more standard gamepad devices. Suppose, hypothetically, that the player were in some sort of gyroscope, amusement park ride, or any other milieu which produced valid input without the player's agency? While unlikely, this example establishes that environmental input is by its nature not wholly controlled by the player, though the player is usually intended to harness, manipulate, or interact with it to some extent.

Maneuvering instructions in *Kirby's Tilt 'n' Tumble.* (ClassicGaming)

Another more recent example is game designer Hideo Kojima's Game Boy Advance title *Boktai: The Sun is in Your Hand*, which has a light sensor protruding from the cartridge. When light strikes the sensor, the game character's "solar gun" loads its ammunition, puddles in the game world evaporate, certain enemies vanish or weaken, and so on; being that the game is about vampire hunting, it is clear that this aspect of the game is not only crucial, but the central principle around which the game was designed. Like the *Tilt 'n' Tumble* controller, the *Boktai* sensor is also "analog" in the sense that the intensity of the light that hits the sensor determines the rate of gun charging; excessively bright light can even "overheat" the solar gun, causing it to malfunction. Another interesting design aspect from the perspective of controller-mediated interaction is the fact that the light sensor is only sensitive to natural sunlight and will not recognize artificial light of any kind, thus imposing the necessity of outdoor play upon the player and limiting the ways that the player might effectively appropriate the game device. This control over a player's gameplay circumstances is deliberate and intentional, as this excerpt from a recent interview with Kojima demonstrates:

> IGNpocket: […] Have testers tried to "trick" the sensor with light other than from the sun?
>
> Kojima: No, we never tried it because we know that it won't work. Nintendo actually asked us, "why don't you have the sensor detect any light?" and that pretty much defeats the concept. With artificial light we have total control...we can turn it on and off whenever we want. The great thing about this concept is that we have no control over sunlight. It might be raining, or it's cloudy, or it's night time...you always think about the sun in this game. It's this thing that you have no control over that gives the game its depth. (Harris)

Kojima raises two relevant considerations; the first is how this sort of environmental input design is adaptive, in that the necessity of natural sunlight obliges outdoor play. The second is the idea that having input beyond one's control is what "gives the game its depth" because it forces the player to "always think about the sun in this game". This quote captures *Boktai*'s subjective play experience rather well: one is constantly and acutely aware of one's surroundings, of the nature of the input, of one's sense of physical presence in the real world, and of the medium itself. In other words, the experience is hypermediate, as the game's interface calls attention to itself and to the player's separateness from the game world; the player in *Boktai* is more akin to a deity figure controlling the onscreen action than an avatar acting within the game experience.

In addition to making the player more aware of the game experience while s/he is actively engaged in it, an uncontrollable environmental input element may also have a more general impact on when, where, and how a particular game is played. For instance, the popular Game Boy games *Pokemon Silver* and *Pokemon Gold* have built-in clocks that determine the date and time of day in the game world; in these games, much like *Boktai*, time is a variable that influences what creatures are available and which in-game events the player can access. Thus, time constrains the player's range of actions, and one may choose accordingly to schedule one's play time around times or dates—a premeditated design choice that extends the influence and logistics of gameplay beyond the confines of active participation in the game.

At first, it may seem odd to classify time as any sort of controller input at all, since, unlike light or air pressure, time itself is a factor that is practically independent of any active manipulation by the player. Where game input is concerned, the only way that a player could influence the passage of time is by transgressive means such as tampering with the game's chronometer, or calibrating it with an incorrect time. However, I would argue that while the player has no immediate efficacy on time input *during* gameplay, the player's decision concerning *when* to play a time-sensitive game is, in effect, a form of input. It seems reasonable that an input factor that exists independently from the game mechanics could be influenced by one's actions and decisions outside of the game.

The example of time as game input illustrates how player influence over environmental input exists on a continuum: at one end, a player has no control whatsoever over the input, and on the other, the player's explicit input is the only thing that the controller can accept[15]. The input's intrinsic manipulability is the main determinant of a controller's placement in this continuum; light and sound are factors that are relatively simple to affect through ordinary means, while time is, as mentioned above, susceptible only to a player's higher-order gameplay decisions. Another determinant of player involvement in environmental input is the player's capacity to recognize and act upon different ways of manipulating the input. For example, while the instructions in *Boktai* encourage players to change their physical position outside in order to regulate the amount of sunlight, staying in one place and covering the sensor with one's own shadow is an equally legitimate use, and not one that necessarily subverts the game's intent: after all, why should changing one's physical location make any more sense than using one's shadow, as long as sunlight is involved?

The accessibility of environmental conditions is not always predictable or reliable, and it may vary depending on the player; for example, players living closer to the North or South Pole may lack the natural sunlight required to play *Boktai* during certain times of the year. However, there are ways to "normalize" gameplay experiences simply by calibrating the game devices to the proper settings. For example, the Sony EyeToy mentioned earlier, which is simply a small video camera, can be refocused or adapted to different lighting conditions, making it usable in a range of environments.

A more interesting problem concerning the normalization of environmental gameplay involves the small-but-growing genre of games based on location input. Beginning with It's Alive's *BotFighters* in 2000 (Baron), location games for mobile devices have been attracting interest among gamers and developers alike. Games like

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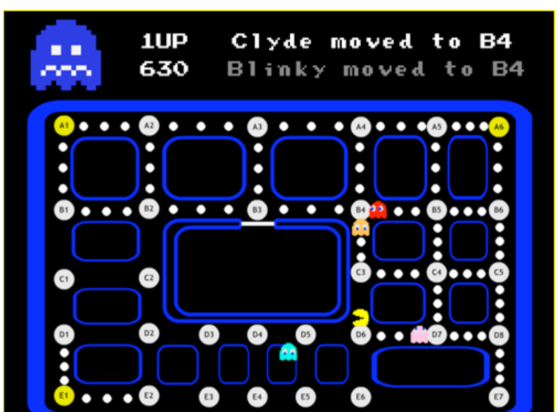
[15] Even standard gamepads and other controllers not designed to accept environmental input are still located somewhere on the continuum, since, as I mentioned in the previous footnote, they theoretically *could* accept non-player input.

GloVentures' *RayGun* and Blister Entertainment's *Swordfish* are among the first North American location games (ibid.); these are relatively simple programs, which have the player physically move to a randomly chosen coordinate within a certain prespecified area and perform a few simple keypad actions[16]. In *RayGun*, for example, the player must move towards the "ghosts" whose locations appear on the GPS screen and "ionize" them with their cell phone, which serves as the titular ray gun; *Swordfish* works similarly in concept. Designers who wish to maintain a consistent gameplay experience using this model face a distinct challenge: the terrain available to each player is unpredictable, and potentially not conducive to "high-intensity" activity (urban areas, indoors, etc.). Of course, this variability might be publicized as a feature—"turning the real world into your game board" (Glofun Games)—but it remains a factor in gameplay.

One way of dealing with the problem of normalizing location-based games is simply to tailor or constrain the game to a single specific setting or locale; despite that this approach vastly limits the potential audience of the game, it opens up a number of interesting possibilities for new kinds of games. One recent example, entitled *Pac-Manhattan*, was developed in NYU's Interactive Telecommunications graduate program in 2004 (pacmanhattan.com). The game is played in the real world, on a grid of city blocks in Manhattan; using cellular phones, players relay their positions to their



Control panel screen capture for *Pac-Manhattan*. (pacmanhattan.com)

[16] GloVentures' website touts their product as a "high-intensity" experience (GloFun Games), since the player is supposed to travel quickly and on foot; like *Boktai*, this illustrates how environmental input often produces some form of adaptation (in this case, exertive).

“Controllers”, which are actually people operating a networked application. The basic rules of the game are as follows:

> *Objective*: Pac-Man attempts to clear the game board of dots before getting caught by ghosts.
>
> *Setup*: 4 players are designated as Ghosts, 4 player are designated as Ghost Generals. 1 player is designated as Pac-Man, 1 player is designated as Pac-Man's General. Ghost Generals and Pac-Man's General fire up the control panel and select the corresponding character names from the list. The Ghosts and Pac-Man proceed to their starting locations. When all players are at their starting stations the Ghost and Pac-Man Generals move their icons to the starting point on the game board.
>
> *The Playing Area*: The Pac-Manhattan grid covers a 6 x 4 block area surrounding Washington Square Park. Intersections are designated by a letter and number starting in the top left corner and continuing left to right…
>
> *Game Play*: At the start of the game, Pac-Man runs along the streets, staying outdoors, within the designated playing area at all times. The ghosts may begin to chase Pac-Man. Pac-Man continues to run the board until all of the dots are "eaten" or one of the ghosts eats Pac-Man.
>
> Upon arriving at a street corner, Pac-Man and the Ghosts must report their new location to their respective Generals. (ibid.)

The input in this game is determined by a player’s report of their location in the playing area; the controllers are defined by the cell phones used to report the locations, as well as the people who update the game application. This game is clearly configured for play in a specific locale, i.e. Manhattan; even though it could be configured for other locations, the basic gameplay experience of running through the streets of Manhattan is unique to that setting.

Although *Pac-Manhattan*’s concept is obviously derived from video gaming, one might argue that it is not truly a “computer game”, because the interactions that take place are unmediated and between people. This is a valid point, since at the heart of it, *Pac-Manhattan* is more like a game of Tag than *Pac-Man*. However, there is no real reason to discount the role of the computer in this game, either, since the means of communicating and maintaining the game state are practically accomplished only with the aid of computer devices. It's no big leap to imagine the human controllers replaced with GPS transmitters, and the human ghost players replaced by the "invisible" ghosts found in *RayGun*. In this case, then, the computer devices enable a form of play that counts as both mediated and unmediated, a expansion of unmediated play by technological means.

The ideas we have discussed in this section suggest a common theme: the more necessary environmental input is to a particular game, the more likely it is that a player's real-world decisions will play an important factor in gameplay. Decisions of when and where to play are important in games like *Boktai* or *Pokemon Silver* and *Gold*, to the point where one might conscientiously schedule their play time in order to have the desired gameplay experiences. In a game like *Pac-Manhattan*, the game might not even seem mediated at all, although it is the mode of computer input that makes it possible. We will see in the next section how this shift to real-world action as input can produce gameplay experiences analogous to those we have previously considered.

V.B Immersion vs. Augmentation

There is the question of whether games based in the real-world like *Pac-Manhattan* can possess the qualities of immersion, as discussed in chapter III. Janet Murray's definition of immersion seems to require that the player feels transported to an "elaborately simulated world", and the hypermediacy imposed by many environmental games would seem to detract from any illusion that one was doing anything other than simply playing a game. These arguments disqualify location games like *Pac-Manhattan* from being immersive, since players are unquestionably aware of their real-world surroundings. However, when we consider a game like *RayGun*, the distinction is less clear. Because the game's premise acknowledges the real world as a factor, yet overlays the real world with its own game elements and narrative, there is a kind of simulation taking place that builds off of the real world rather than creating an entirely new one from scratch.

If the *RayGun* example seems too simplistic to function feasibly as an immersive game, it is because both the technology and the genre are still immature. Already, however, there have been several instances of computer-related games played in the real world which have shown more promise as immersive experiences. In 2004, researchers at the University of Tampere's Hypermedia Laboratory in Finland developed a location-based mobile phone game called *Songs of North*, which uses the conceit of a "spirit world" as a way of explaining the real world context (Lankoski et al. 414). The game's interface reimagines the cell phone as a "spirit drum" which links the real world and the spirit world. Characters in the game communicate to the player through this interface, and the player uses the spirit drum to affect all of his/her actions in the spirit world. Moreover, the game world is persistent, which provides a sense of a game world continuing beyond the player's active involvement in it[17]. In their post-mortem case study of *Songs of North*, the game's designers considered the role of location-based input and the type of gameplay it enables:

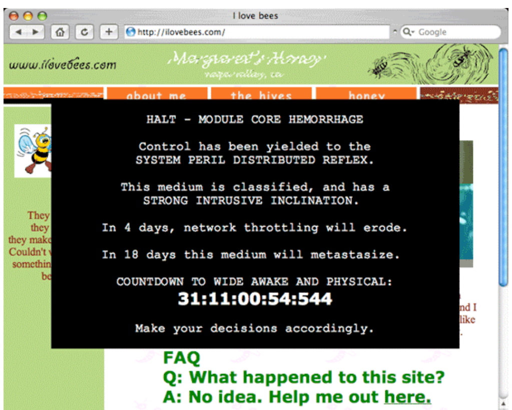
Left: onscreen display. Right: corresponding keypad input. (Lankoski et al. 414)

[17] The notion of persistence in environmental games is a topic I will discuss further in the next section.

> The informants of the player study seemed to consider mobile games as hard to use, or playing with mobile devices was considered meaningless button pushing. When designing a game based on a small handheld device it was therefore important to consider the role of it as an input/output device. In the early stages of the design, the aim was already to integrate the device into the game concept in such a way that would prevent the 'videogame syndrome' that emphasizes the role of a display and pushing buttons.
>
> Our solution while addressing this was to use a player's location as a game element. Since the virtual and physical environments are mapped spatially on each other, the game motivates players to move physically... moving supports efficient collaboration since players can meet physically and talk...
>
> Our player study stressed the requirement of player control. This requirement seems to have even more importance in a mixed media multiplayer game than in online multiplayer games. In SoN the player can choose when to play; there is no penalty for not being present in the spirit world: a player's spirit is not vulnerable to the actions of other players spirits when their players are absent from the spirit world. However, it is possible to continue playing even though the player/character is not present in the spirit world, by communicating with other players/characters. The distinction between in-game and off-game is problematic since the physical environment is always a potential game arena. However, those actions that affect the game mechanics are made only in the spirit world, so that players can choose whether their counterpart in the spirit world is active and visible or not. There is no straight link between a player and her counterpart in the spirit world. A player has a choice to arrange a meeting with other player(s) in the physical environment and explicitly uncover her physical identity. For a player who does not want to be revealed, the game supported messaging tool is available. Also, the location-sensing system supported by the game is based on slight inaccuracy and ambiguity and therefore it also supports anonymity. Players can track other players, locations and other game objects in the spirit world only with some fuzziness. (Lankoski et al. 415-6)

This analysis emphasizes that strategic play action is possible outside of the strict boundaries of the game, which implies that in addition to the choices that one makes while actively playing the game, decisions of when and where to play the game become factors as well, much like the other environmental input games discussed earlier. Because the game can be played anywhere and at any time, the player must be making decisions wherever s/he goes about whether or not s/he could or should be playing. This element of meta-play, the sense of "always playing", is to real-world games what immersion is to virtual worlds: not a sense that one has been bodily transplanted into a simulated game world, but a sense that reality, which is elaborate and spatial by its very nature, has been infused with the game. We might call this phenomenon *augmentation*, after the branch of HCI that deals with overlaying the real world with virtual information displays. Augmentation is similar to immersion in how it offers the player an experience viscerally different than one's normal life. However, whereas an immersive gaming experience creates a reality from scratch, an augmented game permits one to act in new and different ways with one's familiar world.

The appeal of augmentation is best exemplified by a recent gaming trend whose relationship to technology is clear, even if non-mediated versions of it exist. Known as "alternate reality gaming" (ARG)[18], it is a genre of games based in the real-world with elements of role-playing, in which one or many players play through a fictional scenario. In 2001, prominent video game developer Electronic Arts introduced a subscription-based service called *Majestic*, which, by using personal information volunteered by its players, simulated a conspiracy drama set in the real world. Players were contacted via phone, AOL Instant Messenger, and e-mail, and were prompted to visit certain EA-designed websites in order to solve puzzles and unravel the conspiracy. In 2004, another "game" developed by Microsoft and Bungee called *I Love Bees* debuted in the form of a simple website, which certain members of the alternate reality gaming community were directed to visit. The website was a supposedly ordinary amateur website that had been distorted and covered with ominous messages. As time passed, the distortions became more intrusive, and visitors to the site (the players) were eventually informed that an alien intelligence had taken over the site. Players were subsequently directed to visit different real-world



Screen capture of ILoveBees.com. (Harrell)

[18] The discussion of ARGs in this section was informed by the Alternate Reality Gaming Network website (ARGN) and its affiliates.

locations to receive calls at public phones and answer questions, and to visit different websites to gather and discuss information with other players. A community of players formed around discovering the story behind the “invasion”, and when the story had finally run its course, the game concluded with a series of nationwide player meet-ups.

That prominent video game companies like EA and Microsoft released *Majestic* and *I Love Bees* support the notion that ARGs are intended to function as “computer games”, in the sense that players use computers in order to aid their progress in the game. What is notable is that the “input devices” that players use are by no means specifically designed for play; in fact, players simply use general computing and communication devices in much the same way they are typically intended to be used. What this says about alternate reality gaming, then, is that the details of the physical interaction with the input devices matter less; what matters is that the player is using objects from their everyday reality as elements in a game. Rather than provide the sense of escapism associated with immersion, augmentation instead recontextualizes the mundane and the everyday, to much the same effect.

The notion of appropriating general purpose computing devices as controllers broadens our notions of computer-mediated play considerably; for no longer must we even presume that the game state exists in the memory and programming of a computer. Rather, the world is our mainframe, ordinary devices are our controllers, and what defines them as such are simply the perceptions of the player.

V.C Ubiquitous Gaming

In his published work throughout the nineties, former Xerox PARC head researcher Mark Weiser put forth his vision of a technological revolution which he dubbed "Ubiquitous Computing" (henceforth UC), a new paradigm of human-computer interaction in which networked technology is unobtrusively integrated into the physical environment for practical purposes. Weiser's 1991 *Scientific American* article "The Computer for the 21st Century" describes a few simple applications of this sort of technology, including simple household appliances and objects with automated content delivery and information updating capabilities, such that their functionality adapted to new situations—changes in weather, user preferences, environmental parameters, and so on. Another example involves embedding hundreds of inexpensive, simple computing devices into the environment that respond to small sets of verbal commands, recognize people by their own portable computers, and keep track of the positions of all neighboring computers, for purposes as far-ranged as communication, security, location detection, data recording, and information relay.

Placing this phase of computing into a larger historical context, Weiser divides the major trends of computer usage into three phases, naming "Mainframes" and "Personal Computing" as the first two phases, and designating UC as the third ("Ubiquitous Computing"). Phases I and II are characterized, respectively, by "many users sharing a single computer" and "a single user using a single computer"; UC has "many computers sharing each of us" (ibid.), and in 1996 Weiser predicted that the Phase III would overshadow the second sometime between the years 2005 and 2020.

Because the functions and usages of UC devices are so different from devices based on Mainframe and PC modes of interaction, UC design provides many possibilities for new forms of mediated play. From our discussion of the input device thus far, it is apparent that most of the modes of computer play we have discussed thus far belong to either Phase I or II, with one or more players interacting with a single mainframe entity, whether a console or arcade machine or PC. Indeed, it is this paradigm that has allowed us to make a clean definition of the input device as one or a few specially designated "control objects", which come in easily recognizable forms. UC explodes this notion, distributing inputs everywhere in the physical landscape; the full range of functions is not necessarily available to the player at any given time, and inputs may even be invisible and unbeknownst to the user.

A quote by Weiser on the nature of UC helps to illustrate the extent of the difference between UC and previous modes of computing:

> Ubiquitous computing is roughly the opposite of virtual reality. Where virtual reality puts people inside a computer-generated world, ubiquitous computing forces the computer to live out here in the world with people. Virtual reality is primarily a horse power problem; ubiquitous computing is a very difficult integration of human factors, computer science, engineering, and social sciences. ("Ubiquitous Computing")

The concept of the computer-generated world has an added significance where gaming is concerned, for as we have seen, the experience of being and acting in a spatial virtual world plays a vital role to the experience of gameplay. Like some of the environmental games discussed earlier in the chapter, then, UC games introduce the complications of the real world into the realm of computer gaming. In developing a VR game, a designer must focus on designing realistic physics and motion simulators, concocting vivid graphics, and defining classes and parameters of virtual objects. By contrast, a UC game must build itself into the real world, taking into account who and how many will be playing the game, the accessibility of each device, the inherent nonlinearity of the real-world, the management and networking of an arbitrary number of hardware devices, and the task of distinguishing game elements enough to make them recognizable, but unobtrusive in the environment.

The introduction of this new computing paradigm means that the way we define computer interaction must change. In this paper, we have primarily discussed computer interaction and controller usage in terms of a single player focusing his/her attention on a single set of devices; this is because, given the manual operation of controller devices, a player could only be reliably expected to operate a small set of simple devices at once. UC, on the other hand, has many players sharing a potentially huge set of devices simultaneously, with the automated wireless communication between individual devices doing most of the actual operation. The idea is that, because the devices are numerous and able to function and communicate independently of the user, they "provide much greater computational power" (Preece et al. 62). A single person could not hope to consciously perform several specialized tasks in parallel, whereas a network of computers, embedded in the environment and preprogrammed to respond to any number of factors and situations, may easily do so. Weiser and a fellow researcher describe how the act of ubiquitous parallel computing necessitates a type of interaction which they describe as *calm*:

> The most potentially interesting, challenging, and profound change implied by the ubiquitous computing era is a focus on *calm*. If computers are everywhere they better stay out of the way, and that means designing them so that the people being shared by the computers remain serene and in control. Calmness is a new challenge that UC brings to computing. When computers are used behind closed doors by experts, calmness is relevant to only a few. Computers for personal use have focused on the excitement of interaction. But when computers are all around, so that we want to compute while doing something else and have more time to be more fully human, we must radically rethink the goals, context and technology of the computer... (Weiser and Brown)

This philosophy of computing seems antithetical to the goals of play, which have been characterized throughout this paper as attention-engaging, dynamic, reaction-based, and "focused on the excitement of interaction", as Weiser puts it. So what forms might a "calm game" take? While this is a question as loaded as the question of what kinds of games a simple 8-button gamepad can permit, there are a few examples from currently existing game projects and technological services that may serve as introductory examples.

Currently, the most popular ubiquitous computing device is the cellular phone; we have already seen in chapter III how prevalent this technology is in many industrialized nations, and how "attached" to their cell phones people become. Because the microprocessing capacity of these devices far exceed what is necessary to merely place phone calls, a slew of adjunct services and options are currently available at a premium to users, including text messaging, GPS technology, and—most relevant to our discussion—games and wireless Internet access. What these services entail is the existence of hundreds of portable Internet devices attached to their users, each sensing and communicating with one another, and each possessing a wide range of information-based functionality.

A recent interaction trend that may indicate the general direction of ubiquitous gaming is not actually a game at all, but a commercial service: cell phone matchmaking. Services like *Sms.ac* and *Match.com Mobile*, provided by Sprint and other telecommunications companies, offer a location-based network which subscribers can query in order to locate and contact other subscribers in a radius of 5 or 10 miles. The queries can be configured to return matches of a specific height, race, gender, ethnicity, and so on; this serves as an example of how portable, perpetually active technology can enable interaction between one or many computer agents embedded in the environment. A similar cell phone application called Serendipity, developed at MIT in 2004 (Hoffman), illustrates the UC model even more acutely: using Bluetooth technology, the application automatically scans for other cell phones using Serendipity in a 16-foot radius. If other users are found, the two users' IDs are sent to the central server, which compares their corresponding profiles to check for their compatibility, which is based on their preferences, interests, and the weight that the users give to each parameter (specific interests, appearance, etc.). If the two profiles "match", then the server alerts both users, providing the other user's name, photograph, and shared interests. This exemplifies the automated, background functioning of the UC model, since neither user need take any directed action in order for the interaction to take place; rather, the interaction happens incidentally. What a user does and where s/he goes may have nothing to do with the goal of the interaction—in fact, since Serendipity is predicated on the notion that one *cannot* predict where other users may be, it is intended to be used passively, without the user's attention.

This passivity—what Weiser would call "calm"—may be what underlies future games based on UC design principles. Intuitively, a game that one doesn't "play" so much as "let happen" doesn't seem very appealing; however, this approach to gaming shares many characteristics with established genres of computer play that have proven to have enormously popular appeal. Chief among these is the genre known by some as "lifestyle gaming" or "virtual life", embodied and dominated by the current best-selling game of all time, *The Sims*. In these games, specific events and micromanagement strategies are far overshadowed by the emergence of complex character relationships and behaviors from the player's overall approach to the game. The player makes small-scale decisions as to what to buy, what to do, and where to go, without necessarily having a course of action in mind, and almost miraculously, the characters begin to exhibit traits and behaviors consistent with the general patterns of those decisions. After noticing these trends emerge, the player may modify his/her general play strategy, or may simply proceed as usual, handling daily concerns as they come; in other words, it's something like real life. A common criticism made by *Sims* detractors is that "nothing happens" in these games, that there is no excitement, no narrative progression, and no tension—this is the same issue we are addressing with UC gaming in general. However, *The Sims* has retained its best-selling status across repeated iterations and expansions, which suggests that there is much that appeals to people besides fast-paced, attention-absorbing action.

Where UC picks up on the appeal of virtual life is in its capacity to integrate the notion of play or experimentation into one's everyday experience. A virtual life game allows one to consider fairly normal activities such as going to work, brushing one's teeth, and sleeping as different play actions, less for their own sake than for how they contribute to an overall sense of progress and development. In the same way, a UC game can augment the real world by having one's personal game device respond to local devices embedded in the environment or carried by other users. For example, a game might record your whereabouts over the course of a day by noting which devices you were nearby, when, and for how long; this information could then serve as data for a more traditional virtual life game, which uses your actions as a factor for determining the behavior of the in-game characters. The adaptive potential for this sort of game is compelling; it might serve as motivation for a child to go to school everyday, or for someone to stay on the treadmill longer. Another UC game might have proximity to other devices (either held by other players or those in the environment) trigger events or a tasks to be performed on the player's own device; this event triggering might even be random, such that one cannot predict when and to which devices one's own device would respond. This roughly corresponds to the notion of a "random encounter" in a role-playing type game, only in a UC game, the encounters would occur unexpectedly over the course of the player's day; we can already see how services like Serendipity accomplish such encounters. In each of the two hypothetical UC games just described, constant attention to the game is not necessary, and one gets the sense of augmentation that those sorts of games afford.

In the mobile phone archetype of having a versatile personal computer that can respond to other mobile phones as well as central servers, people who are always carrying their devices around come to be identified by their devices. In cell phone dating services like *Serendipity*, users create a (purportedly real) identity for themselves on their stored profiles; this could easily apply to mobile UC games, with each person represented by characters whose information is stored in the device. Within this paradigm it would be likely that many games would emphasize long-term character- or persona-building, and as such, it is useful to talk briefly about yet another salient genre of gaming, the Massively Multiplayer Online Role Playing Game, or MMORPG. This genre is represented by any game which has a large number of players interacting with one another in real-time in one or more virtual worlds, with each player assuming an alter-ego identity with its own unique set of items, abilities, and attributes. The virtual worlds are typically *persistent*, which means that the state of the game is constantly maintained and accessible by any of its current players, so when any individual player logs out of the world, it is likely that the state of the world will be different when s/he logs on again. In this way, it is much like the real world, which certainly does not come to a stop when any of its inhabitants goes to bed for the night. This is not the only similarity, however; the MMORPG has been the object of much study for its microcosmic parallels to real-life phoneomena, including social networks, monetary and trade economy, human interaction, political dynamics—the list goes on, seemingly constrained only by the fact that all game actions and objects are virtual. Most importantly, the technological infrastructure of the MMORPG resembles the UC model in many ways, as it can be viewed as a vast network of interconnected client computers, each associated with a single character and player.

UC introduces new possibilities for this model because of its capacity to integrate virtual game elements into the real world. A UC-based MMORPG can be configured to require proximity between two devices in order to register their interaction. Like location-based games (of which this sort of UC game is a subcategory), this can compel players to perform real-world tasks together in groups; imagine a game in which a device is located on top of a real-world building, and the only way to get close enough to it in order to communicate with it is by infiltrating the building or otherwise getting your device on top of the building. Throughout the game experience, of course, other devices in the environment would react to your personal device, and communicate with still other devices for any number of reasons: perhaps competing groups in the area might be informed through their devices of your whereabouts, or activating a device might update your device with new information or virtual items. Tasks and interactions of this nature mesh well with the cooperative emphasis in many MMORPGs. Because the players' devices are capable of communicating with one another over long distances, however, players need not be proximal in either the real or virtual world in order to cooperate.

This accessibility of both short range and remote functionality is another characteristic of the UC model that distinguishes it from its non-mediated counterparts. One might ask how embedding computing devices in the environment differs from simply using regular non-computer objects; for example, rather than use a device that records a player's position, why not simply have the person leave their signature there? Two things to consider are that the computing device is capable of communicating in real-time with any and all other devices involved in the game, and that the behavior of a device can change instantaneously, for whatever reason. The behavior of certain devices might be configured to change at a certain time, or at the behest of a player or game moderator, or even at random, and it can be multifunctional, responding differently to different players and under different circumstances. Given all of these facts, the actions of a single player at a single location may effectively have an arbitrarily large impact on the game state, across an arbitrary number of devices. Moreover, an embedded device need not be visible, recognizable, or even noticed by the player in order for the interaction to take place

Square-Enix recently introduced *Final Fantasy VII: Before Crisis*, a game for the Panasonic FOMA P900iv mobile phone that employs a number of principles discussed in this chapter. The game requires players to use objects called "materia" in order to perform certain moves, and the only way to activate the materia is to use the cell phone's camera to take pictures of objects in the real world that match the materia's color. This

An advertisement for *Final Fantasy VII: Before Crisis.* (Padilla)

clever use of environmental input encourages players to be vigilant in observing colors in the real world, heightening the sense of augmentation. The materia system is further complicated by the fact that each phone device limits the player to a small amount of materia, so that players are encouraged to trade with one another; furthermore, if a player is low on materia and needs immediate help, s/he can use the "Materia Support System" to contact players in the vicinity. These aspects demonstrate the necessity of having the devices in the environment communicate with one another. Finally, players can join one another's groups and go on cooperative missions; the game is designed for this sort of interaction to take place serendipitously between players, and "not in an MMORPG sense as the creators [wanted] the game to be more random" (Padilla).

The consequences that UC has for play are in many respects the same as those for general computing: UC enables a single player to interact with any number of other players and perform any number of game actions at any time, without concentrating, and in parallel. In the case of general computing, these abilities are merely conveniences by which the user can go about his/her day without being distracted; in play, however, they allow the player to swap intense, directed action for a sense of continuous and complete augmentation. A player need not conscientiously create input in order to perform a huge number of functions in the game, making individual players more potentially agentive and powerful within the game. As in an ARG, the player gets the sense that anybody might be participating in the game, and any object might respond to one's own device. And one might not know which functions any object might have (since their functionally can update and change at any time) and when an interaction could happen. Adding this element of spontaneity and uncertainty to one's everyday experience is precisely the appeal of augmented play; it is the renewed sense that anything could happen, and that one will be prepared when it does.

VI. Conclusion

I love the Power Glove—it's so bad.
Lucas, The Wizard

VI.A Intentions and Motivations

This paper was intended as an accessible, multidisciplinary examination of the issues surrounding technologically-mediated human play, especially those that distinguish it from traditional non-mediated play. The significance of such a study is hopefully clear to the reader by this point, but here I will briefly enumerate the principal contributions that I hope this paper has made to the field.

I should qualify my above allusion to "the field", as my first remark here will be to reiterate the relative scarcity of a body of academically-minded literature centered on technological play. There are several plausible reasons why such a corpus has yet to be formed: the historical novelty of the video gaming medium; computer gaming's status as popular entertainment; or the multidisciplinary nature of the medium, which makes it difficult to form a completely comprehensive account of any single gaming phenomenon. Of course, there are equally as many pragmatic and aesthetic reasons why gaming demands academic investigation: increasing prevalence and exposure of games at all levels and strata of society; the game industry's undeniable economic potency; the potential for engendering a more technologically facile, interaction-minded society; and of course, the human tendency to seek new avenues for play, in all of its capacities.

Over the course of my own research, I have attempted to embrace the multidisciplinary nature of the medium, supplementing my ideas with readings in anthropology, product design, material philosophy, HCI, video game history, and—occasionally, inevitably—common sense. However, I have tried to avoid subordinating the concept of computer-mediated play interaction to any of the other disciplines I've used to study it, in order to place it squarely in the domain of academic video game literature. It is my intention to provide new media academics with a text to react to and to build upon in their own work—the dearth of such material was certainly a challenge I faced in the writing of this paper, as well as one reason why relying on literature from other fields and primary sources was so necessary.

The creation of any sort of academic field demands a thorough definition of the important terms and acknowledgement of its main assumptions, and for this reason the beginning chapters of this paper concentrate on making these terms and assumptions clear. The critical construct that arises from these assumptions is what I have been calling the Three Agent model—the conception of computer-mediated play that emphasizes the equally important, interdependent roles that the player, the C/P device, and the mainframe play in the interactive process, as well as the symmetry of the overall exchange. This is, in turn, a shift away from the view that computer-mediated play can be adequately studied by examining only the player, or only the game, or only the means of play. As a result of focusing on the intermediary between the game and the player, this paper has included discussions of the physical, mental, and virtual worlds which, in tandem, encompass the experience of computer games. Hopefully, this emphasis on examining the holistic play act will proliferate, and we will begin to form a language of play interaction that is as informative of the nature of games as the notions of genre and platform. If a future paper is able to simply describe a style of computer-mediated play as "adaptive" or "liminal" without having to digress into a discussion of all those terms entail, then this paper has done its work.

VI.B The Nature of the Argumentation

My methodology for the most part followed two approaches; the first was to present credible examples of controller design and usage to demonstrate the existence of controller-related phenomena, such as adaptation, appropriation, and the ramifications of environmental input. The second approach was to use existing academic literature in order to establish a vocabulary and a set of core concepts (e.g. play, usability, flow) that best characterize the computer-mediated play experience, and furthermore, to support conjecture about how devices might plausibly be used toward different play ends. I have done my best to apply both of these approaches in support of each argument; however, in many cases, for reasons ranging from the relative immaturity of game technology to the impoverishment of academic video game treatments, it has not always been possible or reasonable to apply both approaches. For the present, it will have to suffice merely to speculate, as Vannevar Bush had, about how one might use the gaming technology of the future, basing our judgments on observations of how we interact with machines and computers, how we perceive ourselves in relation to the objects we interact with, our theories of human behavior, and sheer inference. However, if Edward Tenner's ideas about the cultural determination of device usage are to be heeded, these speculations almost certainly bear presentist and cultural bias; therefore, I will disclaim here that I have written this paper given a specific body of modern literature, a particular set of cultural assumptions, and a range of controller types which, if my own ideas are be heeded, may likely be unrepresentative of the variety of controllers that will exist in the future, or which might exist in different cultures of play.

The enumeration of common controller types in Chapter I of this paper may have been misleading; I do not expect these to necessarily remain the dominant controller paradigms, since the number of human activities that may be modeled into game data, and the technologies one might potentially utilize in order to transduce those activities, are infinite. Case in point: as recently as half a decade ago, when the *Dance Dance Revolution* franchise was introduced to American home consoles, dance pads did not exist in the American game culture, whereas presently they are among the most popular non-gamepad game devices.

I have done my best to ensure that the points I have made apply to devices that may have yet to be invented, but, with the evolution of computer technology as steady and rapid as it has been, I am receptive to the possibility—indeed, I expect—that new modes of computing will be introduced, and that they will enable novel and important forms of play. I hope that future researchers will find reference to ideas put forth in this paper useful in discussing them.

VI.C Central Themes and Conclusion

Though the chapters of this paper were organized around modes of interaction (object interaction, body technology, non-standard interactions, and environmental/UC input hybrids), certain themes recur which help to put the functional and ontological roles of the controller into perspective.

The Controller as Gatekeeper. In both a technical and figurative sense, the controller is a boundary between the player and the mainframe, an intermediary which the player must cross in order to access the content of a game. However, this degree of separation is precisely the source of many of the new play experiences that video gaming makes possible: transduction of physical action into play action, meta-play decision making (e.g. considerations of how to interact with the controller, not just the game), adaptation, and appropriation. Despite its function as a boundary, however, the work of the controller is paradoxically conjunctive; rather than necessarily distancing a player, it can provide the experience of direct manipulation (chapter II), immersion and bodily integration (chapter III), object simulation in the real world (chapter IV), and infiltration of the real world by games (chapter V).

The Disappearing Controller. Consider Mark Weiser's quote at the beginning of the previous chapter. In this paper we have seen how the controller, by various means, ceases to be at the center of the player's attention: it can mimic game objects with its design and usage, it can merge into the body in both a literal and cognitive sense, or it can disappear entirely, disseminating itself into the environment. These effects will only increase as society becomes even more familiar with computer hardware interfaces, and as new kinds of controllers proliferate. Neural and wearable interfaces will diminish the sensory gap between real and virtual worlds, and embedded UC networks will quietly interact with people in real spaces. Objects in our everyday reality—cell phones, personal computers, and even our cars, clothes, and furniture—will become infused with technology, and it's easy to imagine these general-purpose devices being repurposed, transforming simple events like the commute to work or the daily exercise routine into acts of play.

As a result of this expansion and saturation of technology, the distinction between mediated and non-mediated play—a distinction that this paper has labored extensively to establish—will perhaps in the future seem less and less relevant. It will be taken as a given that technology will be a critical component to many forms of play, including some that already exist. Already, the company Sportvision has developed a service called RACEf/x which, by employing a "coordinated system of global positioning devices (GPS), cameras, in-car electronics and computers" (Sportvision.com), tracks the positions of the cars at NASCAR rallies in real time. This input has been used to provide information to spectators, but Sportvision is also planning to a use this information as game input:

> Today, the Sportvision crew is expanding the NASCAR tracking system to interactive television and video games. In these games, an actual race is virtually reconstructed with slightly smaller vehicles and a home player's car is inserted, allowing the gamer to race against the actual drivers. (Perry)

This example not only demonstrates how real-world sporting events are beginning to use the sort of input technologies that we discussed in the later chapters of this paper, but also that the boundaries between computer mediated and non-mediated play are being obliterated almost completely. Viewers sitting at home with their gamepads will play against real-life racers who use the locations of their own cars as their input devices—or are the racers playing against the viewers? Ultimately, the distinction is arbitrary, for in our conceptualization, both players are participating in computer-mediated play. Not only will completely new forms of play emerge, but old forms will come under the auspices of technology.

By now I hope to have discredited the idea that computer mediation truly limits the possibilities for human play in any serious way. In addition to providing us with new ways of extending our minds and bodies into rich virtual worlds, the controller has also proven to be a boon to direct, real-world interaction; consider UC and environmental gaming, where real-world action is enabled and enhanced, not constrained, by computer mediation. But controller devices have done even more than simply give us new ways to play. They have come to signify the arrival of a new form human-computer interaction, one based on the joy of interaction itself, rather than the act of computation. They reveal our underlying play preferences and biases: by the very notion of a controller, we can discern that people want to interact in a way which allows them to develop skill; a way which constrains them but permits them to strive to complete tasks; a way which makes them feel like they're in control.

However great the impact of the controller device has been thus far, the future of computer play is still anyone's guess; given the vast diversity of play preferences, the multitude of new technologies and interaction models that could emerge, the new ways of using existing controllers, and the historically rapid rate of change in the video game industry, it is difficult to predict what kind of games will be popular even ten years from now. Yet what is certain is that, because the controller liberates actions from the constraints of cause and effect, and because it allows one to assert control in a ways that no other kind of object can, we can no longer assume that games must be limited by space or time, identity, the body, or the mind.

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