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## Human–Machine Interaction

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Philosophy has always sought to pose the larger questions in life and provide answers. Two of the most important of these questions are (1) What, if anything, differentiates human beings from all other **[p. 438 ↓ ]** forms of life? and (2) What does it mean to be human? The latter question has recently been extended to include concerns regarding the distinction between humans and machines, especially when these two interact. These questions are addressed in this entry. Its primary frame of reference is the consideration of humans and their interaction with machines.

# Human Beings as Differentiated from All Other Forms of Life

Many differing characteristics have been championed as key elements that differentiate human beings from all other orders of life. In itself, the fact that this question is posed so often indicates how desperately humans have sought to distinguish and divorce themselves from the rest of the animal world. Among the candidates offered are the utilization of language, the capabilities rendered by the opposable thumb, the capacity for an upright gait, and even the form of face-to-face sexual intercourse, which is very rarely practiced outside the human species. Such characteristics are certainly attractive as potential causal explanations, but whether they are, individually or collectively, open to empirical resolution is itself an interesting conundrum. What is offered in this entry is an account founded on the use of advanced forms of tools, specifically machines. As will become evident, we seek also to distinguish “mere” tools from externally powered machine systems.

Evolution is typically associated with Charles Darwin's theory, in which each individual organism adapts to its ambient environment and certain associated and subsequently transmittable advantages are “selected” as a function of experienced, contextually contingent pressures. But what of the process of selection in our contemporary human species? What are the pressures exerted by our environment that currently surrounds us? Most likely, you are reading this tract in book form or via some technological appendage in a designed and “artificial” environment that has been created by human beings who have preceded you. What are the “natural” constraints you are

 

now experiencing? Our answer is that such constraints are now predominantly self-determined. That is, humans have conceived, created, and constructed the main fabric of the modern world in which we live. Thus, although we acknowledge and recognize that there is quite a spectrum of tool use in the animal kingdom and indeed that most living systems look to optimize their own living conditions as far as it is within their control, it is only we humans who occupy a dominantly self-manufactured environment. More formally, specific, species-produced *orthotics,* which then themselves co-adapt, are confined solely to human beings. That co-adaptation occurs at a frequency that is derived from the integration of the respective timescales of change as represented by variation rate in the organism (human) and the orthotic (machine) themselves. Peter A. Hancock and Gabriella Hancock have termed this characteristic *the self-symbiotic species.* This is perhaps *the* dimension that makes human beings unique.

Now one of the great conflicts of the late 19th century can be reconciled. Humans are indeed animals in that they possess the fundamental structure and functions common to all animal life. Thus, Darwin was correct. Yet we are not *only* animals. We have been involved, sui generis, in the creation of a new form of hybrid species in which we are ever more progressively conjoining with the product of our own minds. We are certainly not gods, but we have used what the English mathematician and occultist John Dee (1581) called *thaumaturgike* (he referred to it as a low form of magic) to elevate ourselves beyond any other living system (at least any that is currently known to us).

# What it is and What it Will Be to Be Human

Although we must be careful to distinguish between tools and machines, we can, as a general statement, propose that tools created humans as much as humans created tools. (As Peter Hancock explains, our primary differentiation here is that a machine derives its motive power from a source beyond its immediate user, as compared with a tool, which is directly powered by the individual who wields it.) Furthermore, from a topical examination of brain architecture, we can sequentially conclude that a tool (and its evolutionary offspring, the machine) can be thought of as both a cause and an effect of the imagination. We are *self-symbiotic,* first with tools but now with the machines that we create. In case one doubts this assertion, it is quite possible to induce significant distress in any of our modern **[p. 439 ↓ ]** generation simply by parting them from their

 

handheld computational and communication devices for even just one day! But this process of coevolution is far from finished, and indeed one can reasonably argue that it has barely begun. In light of this development, we now have to ask rather difficult philosophical questions such as “What are the boundaries of the human condition?” It is very evident that we cannot abandon our technology and remain the current incarnation of the present species. Yet technological evolution progresses at a dissociatingly fast rate of development compared with intrinsic human change. Thus, our coevolutionary path seems disproportionately driven by profit-driven, technical advances.

Our linkage with our machines is also becoming physically as well as cognitively more intimate. Many people now have in-dwelling medical diagnostic and therapeutic devices. It will not be long before such implants are primarily elective rather than medically obligatory. What will it mean to be human when we are progressively more machine in composition? At this juncture, the questions of science fiction and philosophical contemplation become intimately and indeed alarmingly related. The issues of ownership, privacy, responsibility, and legal culpability are all immediately brought into play when hardware and software physically enter humanware. And with our viral capitalistic structure, the violent shadow of profit is also sure to enter the equation associated with such deliberations. However, we have been instructed that the purpose of philosophy is not simply to study the world but to change it. Thus, we have to conclude here by asking questions not of what is and what may well be but rather what *should* be. Thus, our conclusion is certainly a value judgment, but in such times, statements of value are mandated.

We are in particular danger of associating, attaching, embedding, and enabling an insufficiently capable biological system (the human being) to an ever more powerful and evidently destructive capacity (the ascendingly complex and interrelated systems of global technology). Our media are decorated with the failures that accrue when the fallible human is overwhelmed by the demands of the voracious machine. If human error is an expression of passive malevolence, we also live with the specter of actively malevolent humans let loose with portable and awesomely destructive weapons. How then can we regulate this emerging symbiosis? Can we inculcate morality (e.g., safety) into technology by steps of pure design? It seems evident that we are in a race to establish the next state of punctuated equilibrium in this symbiotic evolution before we

 

destroy the very fabric of the environment that sustains us. Some observers find reason to believe that we shall fail in this endeavor.

# Human–Machine Interaction: Approaches

Approaches for research (and the theories that drive such science) should therefore understand this unique relationship between humans and the technology they use, so that future design efforts and training methods foster more effective human–machine interaction (HMI) rather than promote discord. To this end, research in this domain has been often multidisciplinary in nature; most commonly, a two-pronged approach combining both behavioral and computer science. Design and industrial engineering provide insight into the mechanical perspective of the human–machine dyad, while cognitive psychology and ergonomics attempt to explain and predict the physical and psychological reactions and performance of the human operator. Human factors psychologists (i.e., those working in the multidisciplinary Human Factors Science or ergonomics), however, merge each of these respective disciplines to work on the HMI as its own complete system, investigating its effectiveness, usability, interface structure, and the like.

# Current Trends

Some of the major areas of interest in HMI today are augmented reality, individuation/customization, and embodied cognitive agents. Augmented reality research looks to create an interface whereby the human is able to perceive an environment with overlaid information that would normally be available to the senses. For example, in the Google Glasses project a person wears a set of transparent glasses to successfully interact with the world in front of her; projected onto the glasses themselves, however, is information about the person's surroundings (i.e., a GPS screen provides her with directions on where to walk, pop-ups alert her that there is a coffee shop near her current location, etc.). But, to come **[p. 440 ↓ ]** to the second major area mentioned above, all such technologies are rapidly becoming more attuned to the individual and less designed for inflexible mass consumption. In particular, with the overwhelming number of personal

 

devices now available, users are able to choose a number of personalized settings: backgrounds, schemes, ringtones, covers, and so on. Moreover, some devices have been programmed to respond only to the sound of an authorized user's voice. We anticipate that such individual customization or individuation will burgeon greatly in the near future.

Other contemporary thrusts have featured embodied cognitive agents through which some machines are now able to reciprocate individuated types of communication. An embodied cognitive agent is a machine or program displaying a limited amount of artificial intelligence (AI), which is anthropomorphized to an extent so as to give the human user a sense of social interaction with the technology. For example, Siri is an application for the iPhone that works as an intelligent personal assistant; “she” is able to vocalize and talk with the user, ensuring that “her” findings are indeed what the user wanted.

# Major Players: Past and Present

Throughout the 20th century, scientists from a number of disciplines contributed significantly to the theories and research underlying HMI. For example, Alphonse Chapanis of Johns Hopkins University is generally considered the father of this area, in particular ergonomics, at least in the United States. Another early luminary was Paul M. Fitts Jr., whose most preeminent contributions concern his law of motor performance and his study of piloting error. As one of the founding fathers of aviation psychology, he was also interested in maximizing the efficiency of human movement necessary to interface with machine (airplane) controls. In respect to decision making as related to HMI, Herbert Simon, educated at the University of Chicago and a Nobel Prize winner in economics, made a significant contribution to HMI research with his work on AI. His work with Allen Newell on the Logic Theory Machine and the General Problem Solver helped further the capabilities of machines to perform more complex, decision-making tasks. Donald Norman, a graduate of MIT and the University of Pennsylvania, has advanced HMI research with his concept of “user-centered design,” which dictates that engineers and designers primarily focus on designing a machine based on the human user's needs rather than on convenient engineering or aesthetics. Last, Ivan Sutherland (who was educated at CalTech and MIT) was one of the pioneering scientists at the

 

forefront of the development of the graphical user interface. His invention, Sketchpad, was the prototype for software on which most modern-day personal computer systems are now based. Sutherland was also one of the computer scientists who contributed to the development of the Internet, arguably the invention that has most radically altered HMI since the advent of technology.

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*See also*

- Agent-Based Modeling and Simulation in the Social Sciences
- Artificial Intelligence
- Evolutionary Psychology
- Machine Consciousness and Autonomous Agents
- Social Studies of Science and Technology
- Technological Convergence
- Technoscience and Society
- Transhumanism and Human Enhancement

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