In 1960, J. C. R. Licklider coined the phrase "man-computer symbiosis". He speculated that "man-computer symbiosis is an expected development in cooperative interaction between men and electronic computers. It will involve very close coupling between the human and the electronic members of the partnership." A more modern phrase for such an interaction is "human-computer symbiosis". In the future, people and computing machines may remain loosely coupled or become very tightly coupled. If some form of tight coupling is achieved, the symbiotic relationship may be very positive and adaptive. Technology advances are making human-computer symbiosis a real possibility. Recent developments like the Apple Watch and research on implantable wireless devices (Borton et al., 2013), have changed the discussion about human-computer symbiosis.

Symbiosis in biology refers to two species of organisms "living together", often with long term interactions. Some researchers in the field of artificial intelligence anticipate a man-computer symbiosis as a transition to more autonomous thinking machines. Smart, neural network software and a computing device will somehow become integrated with a person. Integration will perhaps occur as an implant, a helmet device with direct connections to the human brain and nervous system, or as a wearable like a watch or jewlery. Man-computer symbiosis continues to be more science fiction than science fact, but much progress has been made in creating such capabilities.

The terms intelligence amplification, cognitive augmentation and machine augmented intelligence all refer to using computing and information technologies to assist, help or support a person in making decisions and in thinking. Next generation cognitive systems will be people linked to and supported by "smart" machines. Speculation about a deeper integration of man and machine has been occurring for more than 50 years.

Licklider noted in his 1960 article titled “Man-Computer Symbiosis” that “The hope is that in not too many years human brains and computing machines will be coupled together very tightly, and the resulting partnership will think as no human brain has ever thought and process data in a way not approached by the information-handling machines we know today." According to Wikipedia, Licklider is considered "one of the most important figures in computer science and general computing history."

How would the man-machine partnership work? Licklider explained "In the anticipated symbiotic partnership, men will set the goals, formulate the hypotheses, determine the criteria, and perform the evaluations. Computing machines will do the routinizable work that must be done to prepare the way for insights and decisions in technical and scientific thinking. Preliminary analyses indicate that
the symbiotic partnership will perform intellectual operations much more effectively than man alone can perform them.”

Peter Fingar (2015) writes "While they’ll have deep domain expertise, instead of replacing human experts, cognitive systems will act as decision support systems and help users make better decisions based on the best available data, whether in healthcare, finance or customer service. At least we hope that’s the case." A new generation of embedded or wearable decision support systems may be available soon.

People directly linked to smart machines can perhaps function better than people acting without such support. Will the symbiotic organism remain a person in the sense the term is used today? Will advanced analytics and sensors and massive data stores transform the “wearer” into an inhuman analog of a person? Will a person in a symbiotic relationship with a computing machine ever consider removing the device or turning it off?

Commensalism refers to a symbiotic relationship where one of the organisms benefits greatly and the other is not harmed. Perhaps an integrated thinking machine will be like the bacteria, the probiotics, that live in people and help digest food and provide other benefits. Parasitism is a non-mutual, often harmful, symbiotic relationship. It is hard to imagine how a tightly coupled computing machine could benefit more than its human companion. Perhaps the greater danger is the total dependency of a person on its computing machine.

A pacemaker is an example of human-computer symbiosis. A pacemaker consists of a battery, a computer, and wires with sensors connected to a person's body. "Newer pacemakers can monitor your blood temperature, breathing, and other factors. They also can adjust your heart rate to changes in your activity"... A doctor can program the pacemaker’s computer with an external device. For more information about how a pacemaker works check [www.nhlbi.nih.gov/health/health-topics/topics/pace/howdoes](http://www.nhlbi.nih.gov/health/health-topics/topics/pace/howdoes).

There is much to ponder about man-computer symbiosis. Have we already begun the journey toward complete or partial symbiosis? Will such a symbiosis be beneficial to human kind or harmful? Perhaps the best outcome is partial symbiosis or intelligence augmentation. Perhaps future success will not be found by man or machine alone, but rather will be achieved by individuals who best know how to maximize the capabilities of technology to reach a desired end, cf., Deloitte, [https://qz.com/921114](https://qz.com/921114).

More than fifty years after Licklider's seminal article was published defining a goal of creating a
What is a man-computer symbiosis?

human-computer symbiosis, we are at the threshold or turning point of achieving that goal. My feelings about a human-computer symbiosis are mixed. In some ways it is a logical extension of our past decision support research, in other ways the prospect of a tightly linked relationship of a human being with a "smart" computing machine is frightening.

While the scenario in the 1999 science fiction action film The Matrix is more extreme than most of us desire or want, we as decision scientists must decide how far we want to progress in creating a real human-computer symbiosis. Do we want to create brain-computer interface implants to connect people to computers? Perhaps we want to implant computing and memory chips in people's bodies or brains?

References


What is a man-computer symbiosis?


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