

Who's the Boss?

There is evidence that the conscious mind selects from among possible acts developed by the unconscious. Even lifting a finger may be subject to this shared mental management.

By BRUCE BOWER

The venerable concept of free will, according to a California scientist, needs to be redefined. Sure, you consciously decide to carry out or squelch any number of actions, from picking up a pencil to picking a pocket, but the final intention to act arises unconsciously. You cannot willfully prevent the intention from surfacing, even if it involves what you believe to be unethical behavior. In other words, "free will" does not initiate action; rather, it stands guard,

allowing some intentions to gain expression through appropriate muscle movements, and turning others back.

That, at least, is the picture of human decision-making painted by physiologist Benjamin Libet of the University of California at San Francisco. His scientific canvas is streaked with data from several experiments demonstrating, he says, that a specific pattern of electrical activity in the brain precedes not only simple voluntary actions such as flexing a

finger or wrist but also the awareness of intending to move.

"The conscious mind doesn't initiate voluntary actions," asserts Libet. "I propose that the performance of every conscious voluntary act is preceded by special unconscious cerebral processes that begin about one-half second or so before the act."

Yet free will, he says, is not just a noble illusion. There is about a quarter of a second between conscious awareness of an impending action and its actual occurrence, time enough to permit or cancel the intention. Free will is traditionally viewed as following slower deliberations, "but no matter how much silent choice-making you engage in," says Libet, "the same unconscious processes come into play just before you act."

The most recent research by Libet and his colleagues was published in an issue of *BRAIN* two years ago. In the December 1985 *BEHAVIORAL AND BRAIN SCIENCES*, Libet incorporates those findings and several prior investigations into a theory of voluntary action.

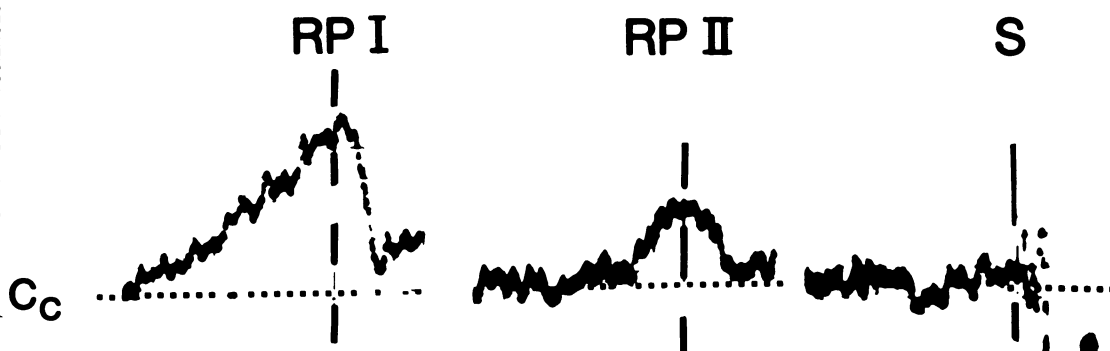
His conclusions hinge on an intriguing scientific method. In one experiment, for example, Libet and his co-workers instructed six healthy volunteers to flex a wrist or finger any time they felt like doing so. Electrodes placed on subjects' heads monitored the "readiness potential," a change in electrical activity generated by the brain. The RP, as it is called,



Tom Walters/UC-San Francisco

Physiologist Benjamin Libet in his laboratory at the University of California at San Francisco. On his right is the skeleton of a cat.

Readiness potentials (RPs) for one subject show a gradual increase before premeditated movement with a sharp drop afterward (RP I), the pattern associated with spontaneous movement (RP II) and a dip in electrical activity after the random presentation of a skin stimulus (S).



has been found by several researchers over the past 20 years to begin up to a second or more before self-paced, apparently voluntary muscle movements. Because a single RP is quite small, each subject performed 40 self-initiated movements and an average RP was calculated.

In addition, Libet devised a way to measure when subjects were first conscious of the intention to move. They noted the position of a rapidly revolving dot of light on a computer-controlled screen (a cathode ray oscilloscope resembling a clock) when the urge to flex a finger or wrist hit them and reported this observation after completing the act.

Among the six subjects, RPs began about half a second before a muscle flexed, while conscious awareness of the intention to move was reported about three-tenths of a second later. In a few trials, subjects reported mentally preparing to move a few seconds before flexing, despite encouragement to make ad lib, spontaneous decisions to move. Even a small number of premeditated moves caused an averaged series of RPs to begin earlier, a little over a second before flexing, and to show more gradual increases in electrical activity than did RPs occurring before impulsive movements. In experiments requiring subjects to deliberately plan actions, adds Libet, the same "ramplike" RPs appear.

The two-tenths of a second delay between awareness of an intention and actual muscle action provides an opportunity for conscious control, says Libet. "Neuronally," he points out, "that's a long time for the selection of events to occur."

A further experiment with the same six subjects supports his contention. They were asked to preplan a muscle flexion, but to block the act about one-tenth to two-tenths of a second before the dot of light reached a prearranged clock position. Ramplike RPs associated with premeditated action appeared about a second before the preset time, but electrical activity flattened out or reversed around two-tenths of a second before movement would have taken place.

"This suggests that the conscious veto interfered with the final development of RP processes leading to action," says Libet, "and agrees with our common intuitive experiences of self-control over urges to act."

Since the initial intention to act arises unconsciously, Libet asserts that religious and philosophical systems "create insurmountable moral and psychological difficulties when they castigate individuals for simply having a mental intention or impulse to do something unacceptable, even when this is not acted out."

A number of neuroscientists from around the world who have reviewed Libet's work accept his experimental design and are fascinated by the results. Nevertheless, the data generate plenty of controversy.

For instance, some researchers point to the tricky nature of pinpointing when a conscious intention arises. The awareness of an urge to move may start slowly and gradually strengthen, says Richard Lato of the University of Liverpool, England, becoming reportable only at some "peak" level. And, he continues, there is an inevitable delay in becoming visually aware of a dot of light.

Perception of a light can precede conscious awareness of the light's presence, responds Libet. A runner in a race can take off within one-tenth of a second after the starting gun, he explains, well before awareness of the noise, but later report hearing the gun before taking off. Libet further notes that when barely perceptible electric pulses were administered to subjects at random intervals, there was an insignificant amount of error in reported clock times of the stimuli.

Other commentators argue that an averaged RP may mask fluctuations in brain activity and measure general arousal rather than electrical rumblings leading to specific acts. There is no evidence that irregular dips and jumps in electrical potential are paved over by the overall RP, answers Libet. The measure has not been linked to attention or expectations, he says, but it is specifically related to a preparation process for actual movement.

Experiments directed by Richard Jung of the University of Freiburg, West Germany, indicate that RPs start up to three seconds before the repeated writing of words such as one's name. Brain activity of that length is probably sparked by a willed intention, says Jung. That may be

so, counters Libet, but a preplanned act that has become automatic, including writing one's name, is not comparable to an act preceded by a conscious intention, such as those he studied. Although automatic acts are set in motion by a general intention, he maintains they "are not of interest when one is studying the nature of conscious intention and control."

The conscious vetoing of relatively spontaneous acts may itself stem from unconscious processes, proposes Robert W. Doty of the University of Rochester Medical Center. That is a possibility that remains to be explored, acknowledges Libet; it is also not known how quickly an act can be evaluated and blocked once a conscious intention appears.

But how well do the laboratory data apply to real-world issues of responsibility and free will? "The Bible's injunction not to commit adultery will be handled very differently from Libet's injunction not to move the fingers on a given trial," comments Bruce Bridgeman of the University of Bielefeld, West Germany. Several plans of action are typically evaluated at the same time, he adds; Libet's findings are important, but he has yet to forge a "physiology of free will."

A conscious attempt must indeed be made not to overgeneralize studies of unconscious intentions, responds Libet. But since subjects' reported times for awareness of wanting to move were nearly the same for spontaneous and preplanned acts, he suggests that some fundamental unconscious brain process initiates all voluntary acts. Furthermore, says Libet, "If you want a philosophy that allows conscious control, and even free will, the experimental demonstration of vetoing an intended act provides an opportunity for it."

These are strong words from a scientist treading on the sacred ground of philosophers. But Libet, who studied sensory awareness for about 20 years before moving into the murkier realm of mind and body, holds out hope that empirical and philosophical avenues can merge. "I happen to believe free will exists," he says. "If it does exist, our experimental data are pointing toward the brain processes that would be involved." □