PSYCHOANALYZING THE STEERING SYSTEM

THE ANATOMY, or physiology, of the steering system is well established; little enough about it has really changed through the half-century of the automobile. But the psychology of steering is another matter, a subject until recently unrecognized and unexplored. As a potential factor in the control of vehicle dynamics, the psychology of steering is a spin-off of space age techniques known as human factors—the study of man-machine relationships.

An 18-man staff directed by Dr. John Versace is doing this work at Ford Motor Company's research and engineering center. The group has developed its first tool, a veritable computer programmer on wheels masquerading as an ordinary 1964 4-door Ford. But the E-H car, as it is called, quickly unmasks itself and flaunts all manner of perversities before the unwary driver. Its schizophrenic moods are varied from manic to depressive by the human factors psychologist in the back seat, stimulating the assorted steering psychoses at a 3-tiered keyboard of switches, dials and gauges.

A *Car Life* editor, first of hundreds of non-company people to be asked to drive the car and select that combination of steering factors which felt best, at first found the steering wheel spinning loosely in his hands. No wonder: The steering column had been sawed off short of the gearbox, severed from all mechanical connection to the front wheels. Instead, a chain and sprockets link the column to a hydraulic motor. Before driving off, the wheel tightened drastically when psychologist Lyman Forbes dialed the electric signal for maximum effort (that of a well-loaded truck) to the hydraulic system. One of a pair of electro-hydraulic servo valves under the hood, obeying the current fed to its electrical side, forced maximum pressure out of its hydraulic half. Forbes gradually reduced pressure as the car zig-zagged down the empty roadway at 25 mph until the feel was "about right" to the driver. Then, switching to the complete absence of feel, pressure was gradually applied until an ideal again was reached. The two points, which should be (and were) about the same, were recorded at the console—although in computer talk that was unintelligible to human editors.

A similar procedure was then used to choose steering ratio, with the second servo doing its job. Full on, it was the 1:1 of a motorcycle and caused a side-to-side lurch with imperceptible pressure on the wheel; it could be reduced to 500:1, requiring extensive turning of the wheel to alter direction. To CL's editor, the ideal was 10:1 (between the 6.5:1 of a rail dragster and the 15:1 of many imports). Again, these data were computerized.

A third characteristic which is varied to determine driver preference is rocking couple, from stiff resistance to spongy softness. Then, for the final test, the console operator switches to a gang of sine wave potentiometers mounted in the trunk; this produces a random pattern of signals to simulate the effect (for the driver) of incipient skids on glare ice under a variety of crosswind conditions. One other capability of the car is negative steer, i.e., turning opposite to what the driver steers.

The data recorded on driver reactions, explains Dr. Versace, are fed to a computer which then reduces these input signals to the parameters of the control system desired. Degrees of over- or understeer, caster, camber, weight distribution and steering gearbox ratios are all printed out by the computer to guide development engineers. Cut-and-try can be avoided.

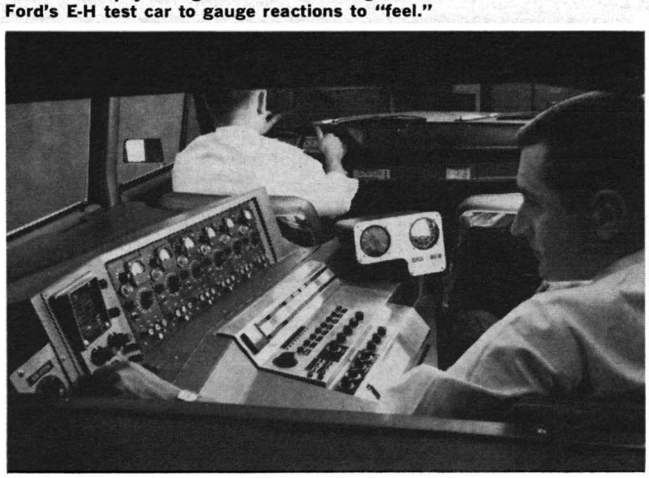
"We really don't have a whole lot of good information on the optimum characteristics of present systems," he explains. "Particularly we are lacking in the interplay between the control of the vehicle and the feel the operator should get. It's our impression that we can go to drastically different kinds of control sensitivity if we tailor the feel properly. I have no idea what this feel ought to be at this present time, which is why we have this test car. But with proper tailoring, it's conceivable that we can get down to extremely low steering ratios."

Dr. Versace cautions that the E-H car "is not oriented toward hardware at all; its entire purpose is to arrive at the functional direction. Then the hardware boys will take over." And, after hearing the results of the editor's test drive, he warned:

"What would be very great for the auto enthusiast, who is very self-conscious about what he's doing, is totally different than for the person who couldn't care less. What is very necessary for the ordinary driver is a vehicle that is very forgiving—he does not have to maintain an instant-by-instant control over it; he can make minor mistakes, minor misjudgments, minor miscalculations and not have them be consequential to him."

IT'S STILL MASS production for a mass market, regardless of the research vehicle. But, ideally, if the circle from test driver through E-H car and computer to production auto is completed, the hardware should be more closely akin to the control mechanism found most desirable to human beings operating it. —*Gene Booth*

BACK SEAT psychologist induces steering madness in Ford's E-H test car to gauge reactions to "feel."



ELECTRO-HYDRAULIC servos obey computer commands to change steering effort, ratio and rocking couple.