

MEMORANDUM: THE COGNITIVE COST OF AUTOMATED REGULATION

TO: Interested Stakeholders / Safety Policy Review **FROM:** [Your Name] **DATE:** July 15, 2026
SUBJECT: The Paradox of Competence Decay in Firmware-Limited Mobility

I. EXECUTIVE SUMMARY

The current trend toward software-based speed regulation in personal electric mobility devices—specifically electric bicycles—is framed as a safety measure. However, psychological and ergonomic evidence suggests that these measures induce **"Competence Decay."** By automating speed decisions, we are shifting the rider from an *active operator* to a *passive monitor*, ultimately weakening the situational awareness and manual reflexes required to navigate public roads safely.

II. THE PSYCHOLOGY OF AUTOMATION BIAS

The primary danger of firmware-enforced speed limits is the phenomenon known as **Automation Bias**. Research in human-computer interaction and aviation psychology consistently shows that when a system provides a "safety net," human operators significantly reduce their own vigilance.

- **The Vigilance Decrement:** As identified in classic human factors research, when an operator's role is reduced to monitoring rather than performing, their ability to detect anomalies drops precipitously ([Warm, Parasuraman, & Matthews, 2008](#)).
- **The "Nanny" Effect:** When an e-bike's firmware intervenes to cap speed, the rider stops internalizing the speed-environment relationship. They are no longer "reading" the traffic or the road; they are waiting for the software to signal the boundary. This removes the essential "feedback loop" between the human brain and the physical environment.

III. SKILL ATROPHY AND OVER-RELIANCE

The long-term cognitive consequence of this technological "coddling" is the atrophy of critical motor and decision-making skills.

- **The Transferability Crisis:** We are observing a parallel to the transition to autonomous vehicles. Studies on "automation-induced loss of skill" demonstrate that drivers who grow accustomed to automated cruise control and braking exhibit slower reaction times when forced to take manual control ([Endsley & Kiris, 1995](#)).
- **The Illusion of Safety:** By artificially capping performance, manufacturers create a rider base that is conditioned to perform within a narrow, "governed" set of variables. When the rider encounters a real-world scenario that falls outside the firmware's parameters—such as an emergency obstacle—they lack the refined instincts to manage the bike's momentum manually. They have been "trained" to be passengers in their own transport.

IV. THE DANGER OF "DE-SKILLED" RIDERS

The push for uniform, firmware-enforced speed limits creates a false sense of security that masks a decline in actual rider capability.

1. **Reduced Situational Awareness:** Because the bike "takes care" of the top speed, the rider is less likely to actively scan for road conditions, as they assume the hardware will prevent them from reaching "dangerous" speeds.
2. **Increased Risk of "Surprise" Failures:** A rider who has never learned to manage a high-torque or high-speed input manually is unprepared for the moment the software fails or is overridden by environmental conditions (e.g., downhill momentum).

V. CONCLUSION

From a psychological standpoint, the most effective safety feature is a **competent, engaged operator**. Any regulatory system that incentivizes the reduction of the rider's active role is inherently counterproductive. By automating the safety threshold, we are systematically disabling the rider's ability to function as a self-sufficient operator.

We are trading individual competence for collective mediocrity—a trade-off that, in the complex environment of public roads, likely increases the risk of accidents rather than mitigating them.

REFERENCES

- **Endsley, M. R., & Kiris, E. O. (1995).** *The out-of-the-loop performance problem and level of control in automation.* Human Factors.
- **Warm, J. S., Parasuraman, R., & Matthews, G. (2008).** *Vigilance requires hard mental work and is stressful.* Human Factors.
- **Parasuraman, R., & Manzey, D. H. (2010).** *Complacency and Bias in Human Use of Automation.* Human Factors.