Technische Universität Dresden

SYNOPSIS

regarding the Dissertation

# HUMAN FACTORS IN E-SCOOTER RIDING

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# SYNOPSIS

This dissertation investigates how human factors, together with infrastructure and vehicle constraints, shape e-scooter riding behavior, with the aim of informing road safety campaigns, infrastructure design, and policymaking and thereby contributing to a safe and harmonious integration of e-scooters into the urban mobility system. It is motivated by the rapid emergence of e-scooters as a new mode of urban transport and by the growing evidence that their spread has been accompanied by increasing crash and injury numbers, frequent single-vehicle falls, conflicts in urban traffic, and elevated risks in nighttime and alcohol-related contexts. Conceptually, the dissertation adopts a human-factors-informed rider-road-vehicle perspective. From this perspective, safety-critical events do not arise from rider characteristics, infrastructure, vehicle properties, or situational context in isolation, but from the way these elements interact in concrete riding situations. On this basis, the dissertation is structured around four explanatory strands: infrastructure choice and rule compliance, interaction between cyclists and e-scooter riders, hazards and coping in everyday riding, and nighttime decision-making after drinking alcohol.

Study 1 examines where e-scooter riders actually ride relative to the available infra-structure and which perceptions and forms of rule knowledge shape these choices. Based on a German field study combining observations and survey data, it shows that riders generally prefer designated cycling infrastructure when it is available, but shift to sidewalks or other non-designated areas when infrastructure is perceived as uncomfortable or inconvenient. The findings indicate that sidewalk riding is shaped less by ignorance of the rules or a genuine preference for sidewalks than by situational factors such as surface quality, directness, and amenity value. This suggests that improving compliance requires not only information, but also infrastructure that is attractive and usable in practice.

Study 2 addresses the social dimension of e-scooter safety by examining how cyclists and e-scooter riders perceive each other in group-based terms and in which situations ingroup-outgroup phenomena emerge. The results show that both groups do distinguish between ingroup and outgroup members, but not in the form of straightforward outgroup derogation. Instead, rule violations by ingroup members tended to be judged more harshly, pointing more toward a black sheep effect than toward strong mutual hostility. From a road safety perspective, this suggests that the main challenge of sharing cycling infrastructure lies less in deep group-based conflict than in coordinating different expectations, speeds, and movement patterns.

Study 3 focuses on hazards and safety-critical events from the rider perspective and examines how e-scooter riders perceive, interpret, and manage safety-relevant situations in everyday traffic. Combining an online survey with focus group interviews, it identifies two broad classes of hazards: infrastructure-related hazards such as potholes, cobblestones, curbs, and slippery surfaces, and interaction-related hazards involving motorists, cyclists, and pedestrians. Riders also report a broad repertoire of coping strategies, ranging from immediate reactions such as braking or swerving to longer-term adaptations such as route choice, speed adjustment, brake readiness, protective equipment, and vehicle modifications. The study shows that many e-scooter safety problems overlap with known cycling safety issues, but are amplified by e-scooter-specific vehicle characteristics and handling demands.

Study 4 examines alcohol-impaired nighttime riding and the situational factors that shape the decision to ride an e-scooter after drinking alcohol at night. Using a conjoint study with young respondents from Switzerland, Germany, and Denmark, it finds that peer influence and the availability of viable transport alternatives are the most decisive factors. Scenarios in which peers opted for a safer alternative or in

which public transport was directly available reduced the likelihood of choosing the e-scooter after drinking. In addition, men, frequent e-scooter riders, and respondents with more permissive attitudes toward drunk riding showed a higher riding likelihood across scenarios. These findings demonstrate that alcohol-impaired riding is not only a matter of individual irresponsibility, but also a context-sensitive mobility decision shaped by social influence, opportunity structures, and attitudes.

Across the four studies, the dissertation shows that e-scooter safety is best understood as a context-sensitive problem of system fit between rider, infrastructure, vehicle, and situational context. Several recurring mechanisms emerge across studies: poor or ambiguous infrastructure increases task demands and encourages both loss-of-control events and adaptive but non-compliant behavior; encounters with other road users become critical when predictability and coordination break down; riders continuously adapt their behavior to perceived demands, opportunities, and constraints; and different use contexts, especially routine riding versus spontaneous nighttime use, produce different constellations of risk. The dissertation further argues that e-scooter safety is partly an extension of familiar cycling-safety problems, but partly a distinct e-scooter safety problem due to features such as small wheels, a standing riding posture, instability during signaling and turning, and the frequent use of shared vehicles. The practical implications are clear. Preventive efforts should not focus on rider behavior alone, but also on the conditions under which riders act. Infrastructure design and maintenance should prioritize smooth surfaces, coherent cycling networks, and clear boundaries between traffic areas. Vehicle design and regulation should place greater emphasis on stability, braking, signaling, and visibility. Road safety campaigns should address not only e-scooter riders, but also motorists, cyclists, and pedestrians, especially where risks arise from shared use of urban road space. In nightlife contexts, interventions should combine communication with improved late-night transport alternatives and, where appropriate, restrictions on the availability of shared e-scooters.

Overall, the dissertation contributes to e-scooter safety research by moving from descriptive crash patterns toward a more explanatory understanding of how safety-critical behavior and outcomes arise. It shows that a human-factors perspective is essential for understanding e-scooter road safety and for developing interventions that are sensitive to infrastructure, vehicle design, social interaction, and situational context.