Human Dynamic, Product Evaluation and Quality, Vol. 131, 2024, 111–121
https://doi.org/10.54941/ahfe1004869

The Readiness of the Elderly for Autonomous Vehicle Technology: An Integrative Review

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ABSTRACT

Currently, an increasing number of drivers are facing challenges associated with the decline in physical function as they age. The widespread adoption of autonomous vehicle technology holds the promise of addressing travel difficulties for older adults. However, older adults encounter difficulties in using autonomous vehicle technology due to their declining physiological conditions and cognitive abilities. Therefore, this paper aims to understand the readiness of older adults for autonomous vehicle technology. The paper applies Human Readiness Level (HRL) to discuss the performance of older adults using three specific autonomous vehicle features—Adaptive Cruise Control (ACC), Blind Spot Warning (BSW), and Lane Departure Warning (LDW). Employing a literature review approach, this paper conducts database screening on the research topics evaluating the readiness and driving performance of older adults for autonomous vehicle technology with the application of HRL and related theories. In total, 15 articles were selected as core literature. We propose recommendations and measures on how to enhance the readiness of older adults for autonomous vehicle technology from both technological and individual perspectives to enhance the readiness of older adults for autonomous vehicle technology and ensure safer travel for them.

Keywords: Human readiness level, Older adults, Autonomous vehicle technology

INTRODUCTION

Currently, the scale and influence of older adults in society continue to grow, and they have become one of the driver groups with the highest risk of severe injuries and fatalities resulting from accidents (Günthner & Proff, 2021). As age increases, older adults become more physically vulnerable, with diminished resistance to impacts compared to young adults. Consequently, older adults often exhibit a higher likelihood of fatalities in traffic accidents (Baldwin, Lewis & Greenwood, 2019).

However, the development of autonomous vehicle technology can effectively ensure the safety of older adults during driving. Evidence demonstrates its ability to significantly reduce driving risks and enhance driving reliability

(Helle, Schamai & Strobel, 2016). Data indicates that 90% of accidents result from human errors, and autonomous vehicle technology can effectively save lives (Morando et al., 2018). In this background, the supportive role of autonomous vehicle assistance can play a substantive role for older adults (Musselwhite, Holland & Walker, 2015). It addresses the declining capabilities of older adults when driving and aids older drivers in achieving safe mobility (Fagnant & Kockelman, 2015).

Nevertheless, there are challenges for older adults in using autonomous vehicle technology. As typical researchers or developers of autonomous vehicle technology are not part of the older-adult population, there exists a significant gap between the developed technology and the actual needs of older adults. The lack of sufficient understanding of new technology within the older adults' results in technology not adequately addressing their physiological characteristics, expectations, and needs. Consequently, many autonomous vehicle technologies are not widely adopted by older adults, indicating a lack of readiness for these technologies (Carrigan & Szmigin, 1999).

Therefore, considering how to enhance the readiness of older adults for autonomous vehicle technology becomes crucial. Past discussions on individuals' readiness for technology primarily utilized HRL. Consequently, this paper employs HRL and related theories to explore the readiness of older adults for autonomous vehicle technology and the challenges encountered during usage. Finally, we provide recommendations from the perspectives of both older adults and the technology to improve the readiness of older adults for autonomous vehicle features.

Methodology

We chose to use Web of Science for retrieving journal articles, publicly published papers, technical reports, and published books. This paper primarily discusses the application of HRL in examining the readiness of older adults for using autonomous vehicle technology and provides recommendations and measures to improve the readiness of older adults. Consequently, we determined the research theme as the application of HRL and related theoretical foundations in studying the readiness of older adults for using autonomous vehicle features, and corresponding searches were conducted based on the three specific autonomous vehicle functions selected in this article.

We utilized the following search terms: "technology readiness level" (TRL), "human readiness level", "technology acceptance model" (TRL), "driver readiness" (DR), "TRL", "HRL", "TAM", "DR", "older adults", "autonomous driving", "autonomous vehicles", "adaptive cruise control", "blind spot warning", "blind spot monitoring", "lane departure warning", "lane keeping system", "lane departure warning system", "ACC", "BSW", "LDW". Additionally, we set filtering criteria: empirical studies using theories or models from TRL, HRL, TAM, or DR, with clear research methods and topic descriptions, complete research outcomes, the application of vehicle assistance systems related to older adults, and articles published in English language after the year 2000. After filtering, a total of 11 articles were identified. Furthermore, due to the limited literature retrieved, we manually searched the reference lists of selected key articles and added 4 more, resulting in a total of 15 core articles. The summary list of the core literature in this article is illustrated in Table 1.

Table 1. List of core literature cited in this article.

Number	Author(s), Year	Research Topic	Reference Contexts
1	(Mankins, 2009)	Review the concept of technology readiness assessment and the development history of TRL. Outlook on the future development direction of technology maturity assessment.	A descriptive discussion of each level of TRL
2	(Adell & Box, 2009)	Test whether the Unified Theory of Acceptance and Use of Technology may be used as a framework for understanding the acceptance of driver support systems and the results support it to a certain extent.	User acceptance application in the field of driving
3	(Chun et al., 2013)	As users age, perceived usefulness and satisfaction of users increase. Older adults can be more willing to accept new types of warnings.	Perceived differences in different forms of tactile warnings of BSW among older adults
4	(Fagnant & Kockelman, 2015)	How to support the development of autonomous vehicles from policy.	Obstacles and policy recommendations for promoting autonomous driving technology
5	(Zeeb, Buchner & Schrauf, 2015)	Explore how drivers' allocation of visual attention during highly automated driving influences a take-over action in an emergency. The determining factor of takeover time is the cognitive process.	The applicable time and research limitations of DR
6	(Wu & Boyle, 2015)	Drivers who use ACC less frequently in distracted or damaged situations are often older and generally confused about how to use cruise speed settings.	Factors influencing drivers' acceptance of ACC
7	(Souders & Charness, 2016)	Review the existing technology adoption frameworks and examine the effects of several factors on the familiarity and trust of older adults in technology.	Measures to increase familiarity and trust in using advanced driver assistance systems in older adults
8	(Eichelberger & McCartt, 2016)	Acceptance of driving assistance technologies is high, less so for LDW. The responses of drivers may differ as crash avoidance technology becomes available on a wider variety of vehicles.	Interview survey on older adults' acceptance of driving assistance technologies
9	(Yang & Kim, 2017)	Two advanced driver assistance systems are tested to compare the effectiveness of visual and auditory warnings.	Old adults exhibit different visual performance to different LDW stimuli
10	(Aksan et al., 2017)	The contribution of individual differences in basic visual and motor function, as well as cognitive function to safety gains from LDW is examined.	The impact of cognitive ability on the performance of older adults using LDW

(Continued)

Table 1. Continued

Number	Author(s), Year	Research Topic	Reference Contexts
11	(Zhang et al., 2019)	The shorter average takeover time is related to higher emergencies. Compared to takeover requests that only use vision or do not use vision, takeover requests that receive auditory or tactile vibrations have no age consistency effect.	DR focuses on driver behavior during the takeover period
12	(Viktorová & Sucha, 2018)	Assess the awareness and acceptance of selected advanced driver assistance systems among a sample of Czech drivers, as well as the factors that might influence it.	Factors affecting the acceptance of autonomous driving technology among older adults
13	(Kim et al., 2022)	Non-Driving Related Tasks (NDRT) have a significant impact on the driver's subjective readiness state, which affects takeover performance.	Factors and judgment methods of DR
14	(Huang & Pitts, 2022)	In complex environments, the response time of dual mode and triple mode warnings is faster for people of all ages and more obvious for older adults.	The influence of age on multimodal signals in driving environments
15	(Zheng et al., 2023)	Investigate the impact of additional training on driver roles and responsibilities when using ACC for drivers. As a result, training on driver roles and responsibilities has an impact on the use of ACC by drivers, particularly useful for older adults.	Behavioral manifestations of older adults using ACC

Older Adults and Theoretical Foundational of Readiness

This section primarily introduces the theoretical foundations of TRL and HRL, discussing how HRL inherits and extends TRL. Given the limited research on applying HRL theory in the field of autonomous vehicles, this section also explores related theories aligned with readiness, namely TAM and DR, providing more extensive discussions in this domain. Consequently, the section summarizes the application of these theories to discuss the readiness and willingness of older adults to use autonomous vehicle features. This serves as a theoretical foundation for the next section, summarizing and enhancing the readiness level of older adults using specific advanced vehicle features.

Technology Readiness Levels

The theoretical foundation of readiness was initially introduced by The National Aeronautics and Space Administration (NASA) through the concept of TRL (Mankins, 2009). The original TRL scale, formulated within NASA, has now been updated to a nine-level scale (Mankins, 2009). The TRL scale is designed to assess the technological maturity of systems concerning their performance, reliability, durability, and operational experience in anticipated environments (Salazar & Russi-Vigoya, 2021).

However, even though the TRL scale ensures the expected functionality of the technical components within a system, it does not encompass the interaction between the necessary technology and human factors crucial for the system's success. In other words, without addressing whether the technology is adequately prepared for human use, the overall deployment readiness of that technology may be compromised.

Human Readiness Levels

To fill this gap in TRL's focus on human readiness, researchers explored another type of readiness scale—HRL (Phillips, 2010). Like TRL, HRL also employs a nine-level scale. HRL gives equal weight to both technology and humans, measuring human readiness when facing new technology. Therefore, HRL's core focus is on exploring whether technology is suitable for human use. Additionally, HRL is applied in specific domains and technologies involving relevant human system experts. It simplifies human readiness levels through a one-to-one mapping of the nine levels of the system, facilitating communication with decision-makers in the engineering field.

Similar to TRL, the HRL scale qualitatively describes different readiness levels but lacks quantitative measures and progress standards for each level from an empirical perspective (OECD, 2021). In practice, the HRL scale is suitable for any organization involved in designing and developing technology and systems for various expected human users (2021). However, the behavior of technology and humans dynamically evolves depending on the scope of discussion. Therefore, the criteria for using the HRL scale in different systems need specific distinctions. As of now, no research has been found applying the HRL scale to assess, test, and optimize the human readiness level of technology in the field of autonomous vehicles.

Technology Acceptance Model

Related to readiness, TAM is a classic theoretical model used to investigate factors influencing people's acceptance or rejection of information technology, originally developed by Davis based on the Theory of Reasoned Action (Davis, 1989). Currently, TAM has been widely used by researchers to understand the individual's acceptance of various types of information systems, including in the field of autonomous vehicles. In a driving context, Adell suggested that technology acceptance is the "degree to which an individual intends to use a system and incorporate it into their driving when available" (Adell & Box, 2009).

Studies indicate that age has a positive impact on technology acceptance, while other research suggests that age has a negative or insignificant influence (Souders & Charness, 2016). However, TAM itself was not specifically designed for older adults, and it cannot provide a linear relationship with age, making acceptance in older adults unclear. Additionally, TAM emphasizes the impact of usability and usefulness on technology adoption, focusing on user attitudes and willingness to accept, but it does not specifically emphasize the objective readiness status of users for technology.

Driver Readiness

According to ISO/TR20195-1, DR is defined as the state indicator where the driver regains control of the vehicle from the system and resumes manual driving, affecting the subsequent driver intervention performance (ISO, 2020). For a human driver to safely regain control of the vehicle from an autonomous vehicle system, the driver needs to maintain an appropriate level of DR before receiving the takeover signal alert. Factors affecting readiness include the driver's age, manual driving skills, situational awareness, attention, location, engagement in non-driving tasks, and confidence in the autonomous vehicle system (Kim et al., 2022). Thus, by analyzing the driver's driving behavior to obtain the visual, auditory, cognitive, and psychomotor usage status, a precise value of DR can be calculated to determine if the driver has reached the takeover state (Kim et al., 2022).

Research on DR mainly focuses on the required safe takeover control time when the driver is at the takeover moment and how to signal the takeover request (Zhang et al., 2019). It emphasizes the driver's instant readiness level under this specific critical condition rather than the driver's normal readiness state when facing an autonomous vehicle system.

Readiness of Older Adults for Autonomous Vehicle Technology

Research predicts that the Society of Automotive Engineers Level 5 (SAE L5) will not be expected to enter the market for at least the next 20–30 years (Litman, 2020). Most vehicles will operate at SAE levels 1–3 at this stage, where only specific driving tasks are automated (Huang & Pitts, 2022). Therefore, this section will select several specific vehicle assistance systems as representatives to discuss the performance of older adults using them.

Firstly, we conducted a screening based on the technologies that various manufacturers emphasized when promoting cars, the popular screening criteria listed on various car selection websites, and the technologies mentioned more in the literature. We summarized the mainstream vehicle assistance systems currently used in SAE L1-3 vehicles, totaling 26 systems. Subsequently, we refined the selection based on factors such as the technology's market introduction time, market penetration, available data richness, and older adults' usage performance. As a result, we chose ACC, BSW, and LDW as the three vehicle assistance systems for analysis.

Next, we will analyze the current usage status of these three features by older adults, discuss the challenges posed by existing features in their usage by older adults, and propose recommendations to enhance the readiness of older adults based on HRL and older adults' performance.

Adaptive Cruise Control

ACC assists drivers by partially automating longitudinal vehicle control to maintain a specific driving speed and a safe distance from the vehicle in front. For example, the Toyota Sienna and Prius models feature the ACC system known as Dynamic Radar Cruise Control, equipped with radar sensors to detect vehicles ahead (Eichelberger & McCartt, 2016). When a vehicle is detected, and deceleration is insufficient to maintain the gap, an audible warning is issued to alert the driver (Eichelberger & McCartt, 2016).

For older adults, ACC does not exhibit a high level of technological readiness. When older adults use ACC, they encounter issues with the slow activation of the ACC system and are more prone to disengaging from the system compared to younger individuals (Zheng et al., 2023). Schaefer proposed that due to limited attentional resources, older adults might find it particularly challenging to simultaneously perform two tasks. Consequently, their involvement in ACC may result in insufficient allocation of attention to the forward-driving scenario, leading to older adults failing to reach the required readiness level for ACC use (Schaefer, 2014). Furthermore, older adults exhibit more cautious behavior when using ACC in situations with distracting elements, potentially resulting in a higher rate of ACC disengagement (Wu & Boyle, 2015). Zheng conducted background training on ACC for drivers of different age groups. They discovered that older adults who completed basic training had lower utilization rates of ACC compared to those who underwent comprehensive training (Zheng et al., 2023). However, the ACC usage patterns during the measurement period were similar between older adults who completed comprehensive training and young individuals (who completed basic or comprehensive training) (Zheng et al., 2023). Therefore, Pre-ACC training can effectively enhance the technical preparedness of older adults. Moreover, the level of detail in ACC-related knowledge covered during training correlates positively with the degree of improvement in technical readiness.

Thus, we summarize recommendations to improve the readiness level of older adults for ACC. For older adults, advanced training on ACC procedural operational skills can be provided. For example, informing the activation and deactivation procedures, how to adjust set speeds, etc., and imparting higher-order cognitive knowledge, such as understanding their responsibility as drivers and the allocation of attention resources, can enhance their theoretical understanding of ACC technology, effectively lowering the technological readiness threshold. On the other hand, improvements can also be made to ACC. The lack of consistency in training materials and terminology explanations among different vehicle manufacturers imposes a burden on older adults' learning capabilities (Abraham, Reimer & Mehler, 2018). Therefore, standardizing industry-wide terminologies and usage specifications for ACC can reduce the difficulty in preparing for ACC. Furthermore, ACC warning prompts for older adults should be strategically placed based on their sensory characteristics, incorporating clearer visual or auditory feedback settings and employing multisensory cues to compensate for age-related declines in vision and hearing. This approach aids in shortening response times and facilitating a smoother reception of the current ACC operational status and executed actions.

Blind Spot Warning

BSW utilizes radar sensors or ultrasonic waves to detect traffic within the blind spot of the vehicle's side mirrors. When other road users are detected in the blind spot, it issues warnings to the driver, assisting in lane-keeping and lane-changing maneuvers. Like other collision avoidance systems, the warnings can be visual, auditory, or tactile in nature (Chun et al., 2013).

A simulator experiment discovered a decreased frequency of turn signal use by older adults when utilizing BSW (Chun et al., 2013). This suggests that BSW helps drivers quickly react to whether vehicles are in the designated lane, leading to a diminished role for turn signals. Reports on the subjective impressions of older drivers using BSW systems indicate a higher likelihood of frequent false warnings during adverse weather conditions (Kessler et al., 2012).

Similarly, we propose recommendations to improve the readiness of older adults for BSW. Firstly, considering that BSW is designed to supplement traffic information beyond the Useful Field of View (UFOV) of drivers to enhance driving safety, the technology should account for the visual conditions of older adults. Adequately compensating for the age-related loss of UFOV in older adults can effectively improve their readiness level for BSW. Secondly, when issuing warnings to older adults, the system should prioritize the form of information delivery. Conducting explicit experiments to determine which form and sensory modality result in the lowest level of attention diversion for older adults can enhance the technological readiness of the system. Lastly, research investigating the feedback of drivers using various autonomous vehicle technologies indicates that, compared to other systems, "safety purposes" are the primary reason for using BSW, considered the most desirable feature in safety-promoting systems (Kessler et al., 2012). Therefore, emphasizing the explicit purpose of BSW to older adults in advance can effectively boost their enthusiasm for the technology.

Lane Departure Warning

LDW is a system that assists drivers in reducing traffic accidents caused by lane departure through warning alerts. Taking the Toyota Sienna model as an example, LDW uses a camera to monitor lane markings. When the vehicle is running at speeds above 30 mph and lane departure is detected, it issues rapid beeping, lane lines flashing on the visual display, and slight steering wheel vibrations to alert the driver (Eichelberger & McCartt, 2016). Additionally, many manufactured LDW systems, due to safety considerations, typically activate only at or above preset minimum speeds. Some systems may also reduce performance under certain road conditions or unusual weather conditions.

Regarding the older adults' use of LDW, research indicates that in real driving environments, older adults demonstrate different visual scanning patterns and driving performance in response to various types of LDW stimuli (Yang & Kim, 2017). Additionally, older adults are more likely to activate LDW, and their reaction times to LDW activation are slower. However, older adults with better cognitive abilities have fewer LDW activations and quicker correction speeds (Aksan et al., 2017).

Furthermore, we also put forward recommendations for improving the readiness of older adults for LDW. Firstly, for older adults, it is crucial to ensure cognitive readiness regarding the activation conditions of LDW before operating, which helps to allocate their attention resources reasonably to ensure driving safety. Similarly, LDW should also make improvements. To make the warning system universally effective for older adults, a differentiated setting of warning lead times should be implemented based on varying cognitive abilities. For older adults with longer reaction times, issuing warning signals in advance can enhance the readiness level of LDW. The specific lead time needs to be experimentally validated. Additionally, if LDW can operate across all speed ranges, it will enhance the consistency of the system for older adults, thereby improving their ability to utilize warning information.

SUMMARY

Based on the analysis of older adults' driving feedback and readiness for three specific technologies, combined with HRL, we summarize strategies to enhance older adults' readiness for autonomous vehicle technology. Our recommendations encompass both the technological aspects and older adults' performance.

On the one hand, we propose four suggestions to improve and enhance autonomous vehicle technology. **Firstly, tailor information feedback to match the level of physiological and cognitive decline in older adults.** For instance, consider multisensory cues, such as audio-visual combinations or multiple tactile prompts, to compensate for sensory decline and reduce older adults' reaction time. **Secondly, deliver information feedback to older adults clearly and concisely.** Reports indicate that drivers aged 65 and above express concerns that the system might distract their attention from driving tasks or fail to issue timely warnings for corrective actions (Regan et al., 2002). Therefore, when the system needs to convey information to older adults, it should be simplified the presentation format of prompts to minimize attentional demands and avoid distractions. **Furthermore, segment the older adult population for more nuanced technological design.** Acknowledge the significant variations in physiological perception and cognitive abilities within the older adult demographic. Avoid treating older adults as a homogeneous group; instead, differentiate between younger and older seniors, those with strong and weak cognitive abilities, and refine technology accordingly. **Finally, optimize technological constraints.** Enhance sensor sensitivity, minimize error rates in adverse weather or special road conditions, reduce activation constraints, and mitigate false warnings.

On the other hand, we have two suggestions for older adults' behaviors. **One is to provide early exposure to relevant technological information.** Older adults can receive promotional training before using the technology, gaining prior knowledge of its basics. Tailor promotional efforts differentially for seniors with varying educational backgrounds. For example, those with strong learning abilities may benefit from textual learning through manuals, while others may need practical trial and error before use. Research has shown that compared to other technologies, "safety purpose" is the main reason why drivers prefer BSW and is considered the "most desirable" system in promoting safety (Viktorová & Sucha, 2018). Therefore, informing older adults in advance of the auxiliary advantages of technology can effectively enhance their enthusiasm for using it. **Besides, conduct regular readiness assessments.** Given the rapid advancements in autonomous vehicle technology and the changing physical conditions associated with aging, scheduling periodic readiness checks for older adults can allow for timely evaluations of their driving safety risks.

CONCLUSION

This paper, grounded in readiness theory, elucidates the challenges faced by older adults in utilizing autonomous vehicle technologies and proposes strategies to enhance their readiness. Focusing on three specific autonomous vehicle technologies, the article outlines challenges encountered by older adults during their usage. Recommendations for improving older adults' readiness levels for autonomous vehicle technologies are provided from both the perspectives of older adults and technological optimization. Recognizing older adults as a demographic with a rising proportion in the driving population and significant potential beneficiaries of autonomous vehicle technology, this paper aims to elevate their readiness through the proposed suggestions and measures, facilitating safer usage of autonomous vehicle technology for older adults.

REFERENCES

Abraham, H., Reimer, B. & Mehler, B., 2018, 'Learning to Use In-Vehicle Technologies: Consumer Preferences and Effects on Understanding', *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 62(1), 1589–1593.

Adell, E. & Box, P. O., 2009, 'Acceptance of Driver Support Systems'.

Aksan, N., Sager, L., Hacker, S., Lester, B., Dawson, J., Rizzo, M., Ebe, K. & Foley, J., 2017, 'Individual differences in cognitive functioning predict effectiveness of a heads-up lane departure warning for younger and older drivers', *Accident Analysis & Prevention*, 99, 171–183.

Baldwin, C. L., Lewis, B. A. & Greenwood, P. M., 2019, *Designing Transportation Systems for Older Adults*, CRC Press.

Carrigan, M. & Szmigin, I., 1999, 'In pursuit of youth: what's wrong with the older market?', *Marketing Intelligence & Planning*, 17(5), 222–231.

Chun, J., Lee, I., Park, G., Seo, J., Choi, S. & Han, S. H., 2013, 'Efficacy of haptic blind spot warnings applied through a steering wheel or a seatbelt', *Transportation Research Part F: Traffic Psychology and Behaviour*, 21, 231–241.

Davis, F. D., 1989, 'Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology', *MIS Quarterly*, 13(3), 319.

Eichelberger, A. H. & McCartt, A. T., 2016, 'Toyota drivers' experiences with Dynamic Radar Cruise Control, Pre-Collision System, and Lane-Keeping Assist', *Journal of Safety Research*, 56, 67–73.

Fagnant, D. J. & Kockelman, K., 2015, 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations', *Transportation Research Part A: Policy and Practice*, 77, 167–181.

Günthner & Proff, 2021, 'On the way to autonomous driving: How age influences the acceptance of driver assistance systems', *Transportation Research Part F: Traffic Psychology and Behaviour*, 81, 586–607.

Helle, P., Schamai, W. & Strobel, C., 2016, 'Testing of Autonomous Systems – Challenges and Current State-of-the-Art', *INCOSE International Symposium*, 26(1), 571–584.

Huang, G. & Pitts, B. J., 2022, 'The effects of age and physical exercise on multimodal signal responses: Implications for semi-autonomous vehicle takeover requests', *Applied Ergonomics*, 98, 103595.

Kessler, C., Etemad, A., Alessendretti, G., Heining, K., Selpi, Brouwer, R., Cserpinszky, A., Hagleitner, W. & Benmimoun, M., 2012, *European Large-Scale Field Operational Test on Active Safety Systems | TRIMIS*.

Kim, J., Kim, W., Kim, H.-S., Lee, S.-J., Kwon, O.-C. & Yoon, D., 2022, 'A novel study on subjective driver readiness in terms of non-driving related tasks and take-over performance', *ICT Express*, 8(1), 91–96.

Litman, T., 2020, 'Autonomous Vehicle Implementation Predictions: Implications for Transport Planning'.

Mankins, 2009, 'Technology readiness assessments: A retrospective', *Acta Astronautica*, 65(9), 1216–1223.

Morando, M. M., Tian, Q., Truong, L. T. & Vu, H. L., 2018, 'Studying the Safety Impact of Autonomous Vehicles Using Simulation-Based Surrogate Safety Measures', *Journal of Advanced Transportation*, 2018, 1–11.

Musselwhite, C., Holland, C. & Walker, I., 2015, 'The role of transport and mobility in the health of older people', *Journal of Transport & Health*, 2(1), 1–4.

OECD, 2021, *OECD Science, Technology and Innovation Outlook 2020: Science and Innovation in Times of Crisis*, OECD.

Phillips, E. L., 2010, 'The development and initial evaluation of the human readiness level framework'.

Regan, M. A., Mitsopoulos, E., Haworth, N. & Young, K., 2002, 'Acceptability of In-Vehicle Intelligent Transport Systems TO Victorian Car Drivers'.

Salazar & Russi-Vigoya, 2021, 'Technology Readiness Level as the Foundation of Human Readiness Level'.

Schaefer, S., 2014, 'The ecological approach to cognitiveâ€"motor dual-tasking: Findings on the effects of expertise and age', *Frontiers in Psychology*, 5.

Souders, D. & Charness, N., 2016, 'Challenges of Older Drivers' Adoption of Advanced Driver Assistance Systems and Autonomous Vehicles', in J. Zhou & G. Salvendy (eds.), *Human Aspects of IT for the Aged Population. Healthy and Active Aging*, Lecture Notes in Computer Science., vol. 9755, pp. 428–440, Springer International Publishing, Cham.

Viktorová & Sucha, 2018, 'Drivers' Acceptance of Advanced Driver Assistance Systems – What To Consider?', *International Journal for Traffic and Transport Engineering (IJTTE)*, 8.

Wu, Y. & Boyle, L. N., 2015, 'Drivers' engagement level in Adaptive Cruise Control while distracted or impaired', *Transportation Research Part F: Traffic Psychology and Behaviour*, 33, 7–15.

Yang, X. & Kim, J. H., 2017, 'The effect of visual stimulus on advanced driver assistance systems in a real driving', *IIE Annual Conference*.

Zhang, B., De Winter, J., Varotto, S., Happee, R. & Martens, M., 2019, 'Determinants of take-over time from automated driving: A meta-analysis of 129 studies', *Transportation Research Part F: Traffic Psychology and Behaviour*, 64, 285–307.

Zheng, H., Mason, J. R., Classen, S. & Giang, W. C. W., 2023, 'Pilot study: Effect of roles and responsibility training on driver's use of adaptive cruise control between younger and older adults', *Transportation Research Part F: Traffic Psychology and Behaviour*, 94, 53–66.

2020, *ISO/TR 21959-1:2020(en), Road vehicles — Human performance and state in the context of automated driving — Part 1: Common underlying concepts*.

2021, *Human Readiness Level Scale in the System Development Process*.