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UNDERSTANDING MILITARY DRIVING BEHAVIOUR: A SCIENTOMETRIC AND SCOPING REVIEW OF GLOBAL RESEARCH TRENDS AND GAPS

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ABSTRACT

This study undertakes a comprehensive scientometric and scoping review of the global research landscape pertaining to driving behaviour within military contexts. The objective is to delineate research trajectories, theoretical underpinnings, and interventional strategies that directly impact driver safety and performance. Data were extracted from the Scopus and Web of Science databases, resulting in a corpus of 170 publications. These were analysed using ScientoPy and VOSviewer to assess publication trends, keyword co-occurrence patterns, and institutional contributions. A supplementary scoping review, informed by the SPIDER framework, synthesised evidence from intervention-focused studies. The scientometric analysis reveals a consistent increase in research output since 2005, with a notable acceleration post-2015, particularly in areas concerning driver performance, fatigue, driving outcomes among veterans, and safety interventions. However, the field exhibits conceptual limitations; only game theory and molecular dynamics theory were explicitly identified as foundational frameworks. This indicates a conspicuous absence of psychological, behavioural, and human factors theories to elucidate driver decision-making and performance under operational stress. The scoping review identified three primary intervention categories: digital educational, behavioural, and psychological. These interventions demonstrated quantifiable improvements in safety-related outcomes, including reductions in fatigue, sleepiness, road hostility, and crash risk. Notwithstanding these encouraging findings, the literature is marked by methodological heterogeneity, a paucity of longitudinal evaluations, and limited theoretical integration, thereby restricting the generalisability and long-term efficacy of the interventions. By explicitly connecting driver behaviour to occupational safety, human performance, and workforce sustainability, this study contributes to Sustainable Development Goal 8 (Decent Work and Economic Growth). It demonstrates how evidence-

based military driving interventions can mitigate non-battle injuries, conserve skilled human capital, enhance operational productivity, and foster enduring organisational resilience within defence institutions.

Keywords: Military driving behaviour, scientometric analysis, psychological interventions, fatigue management, Sustainable Development Goal 8 (SDG 8)

INTRODUCTION

Military driving is characterised by operations in high-pressure environments and the necessity for precise execution of operational duties. This distinct form of driving frequently occurs under conditions that require rapid decision-making and adaptability. Research on military tactical adaptive decision-making under stress highlights that resilience and cognitive readiness are crucial for maintaining performance during simulated military operational stress (Sekel et al., 2023). The high-stakes nature of military driving is further complicated by the necessity to navigate hazardous conditions, such as poor visibility caused by environmental factors like smoke or fog. These challenges necessitate specialised equipment and techniques to ensure the safe operation of vehicles (Malygin & Tarantsev, 2022). Additionally, military drivers frequently operate in challenging terrains, including flooded areas or damaged roads, which require vehicles specifically designed for such conditions (Malygin & Tarantsev, 2022). The integration of advanced technologies, such as thermal imagers, is essential for maintaining safety and operational efficiency in these environments (Malygin & Tarantsev, 2022). Furthermore, the driving behaviour of military personnel can be analysed using naturalistic driving data, which aids in understanding and mitigating risk behaviours that could lead to accidents (He et al., 2022). This approach parallels civilian studies that monitor driver behaviour through multimodal data collection, emphasising the importance of understanding psychophysiological and environmental influences on driving performance (Tavakoli et al., 2021). Overall, military driving demands a combination of technical skill, psychological resilience, and adaptability to effectively manage the unique challenges posed by operational duties in high-pressure and hazardous environments.

Road traffic accidents in military environments represent a significant concern, particularly in conflict zones where non-battle injuries (NBI), such as motor vehicle crashes (MVCs), are prevalent. During military operations in Iraq and Afghanistan, MVCs accounted for a notable proportion of serious NBIs, with a case fatality rate of 6.5% associated with these incidents. This statistic underscores the dangers faced by military personnel in such environments (Kauvar & Gurney, 2020). In comparison, global civilian road traffic injuries (RTIs) constitute a leading cause of death, resulting in approximately 1.25 million fatalities annually and 20-50 million injuries, thereby creating a substantial public health burden (Gu et al., 2025). Despite the rising incidence of RTIs in civilian contexts, the rates of death and disability-adjusted life years (DALYs) have decreased over time, with the highest accident rates observed among young adults aged 20-24 (Xu et al., 2022). In regions such as Bosnia and Herzegovina, the implementation of stringent laws has significantly reduced RTI fatalities, demonstrating the potential for policy interventions to mitigate these incidents (Cilovic-Lagarija et al., 2022). In Iraq, road traffic fatalities rank among the top ten causes of death, with a high proportion of pedestrian fatalities, particularly affecting children and young men (Leidman et al., 2016). While military environments face unique challenges due to operational conditions, the elevated incidence and fatality rates of road traffic accidents in both military and civilian settings underscore the urgent need for targeted prevention strategies and interventions to reduce these occurrences on a global scale.

Understanding driving behavior in military populations is of paramount importance, given that service members are exposed to unique behavioral, psychological, and health-related risks, particularly among

those with combat exposure and service-related mental health conditions such as traumatic brain injury (TBI) and post-traumatic stress disorder (PTSD). Empirical evidence indicates that veterans returning from deployments in Iraq and Afghanistan exhibit elevated rates of motor vehicle accidents and fatalities compared to their civilian counterparts, a phenomenon influenced by combat conditioning, risk-seeking proclivities, and military driving norms (Whipple et al., 2016). Furthermore, driving-related anxiety, frequently associated with PTSD and depression, is prevalent among recently deployed personnel and can manifest as hyperarousal in civilian driving environments, such as instances of vehicular proximity or traffic congestion (Zinzow et al., 2013). Despite the prevalence of these symptoms, help-seeking behavior remains limited, underscoring the necessity for targeted interventions that mitigate stigma. Conversely, longitudinal research suggests that the implementation of stringent policy enforcement and comprehensive road safety campaigns can effectively reduce risky driving behaviors over time, as demonstrated in studies of UK military personnel (Sheriff et al., 2015). Collectively, these findings underscore the exigency of examining driving behavior within the frameworks of both psychological vulnerability and institutional context.

The prevalence of unsafe driving practices within military operational environments yields considerable consequences, encompassing non-combat injuries, fatalities, equipment degradation, and mission compromise. While overall fatality rates have declined, motor vehicle collisions (MVCs) persist as a primary cause of mortality among military personnel, thereby underscoring continued exposure to driving-related hazards (Krull et al., 2004). Empirical evidence indicates a high incidence of near-miss events and hazardous driving behaviors during routine operations, particularly among junior enlisted personnel, reflecting disparities in experience, oversight, and exposure to risk (Schram et al., 2018). Operational stressors, including elevated workloads, temporal constraints, and environmental ambiguity, may interact with individual risk factors, such as alcohol consumption, to exacerbate the severity of collisions, especially among younger service members and Airmen (Kesisiklis, 2011). Moreover, rollover incidents involving armored military vehicles present a disproportionate risk of severe head trauma and mortality, thereby emphasizing the imperative for enhanced training paradigms, vehicle engineering, and safety protocols (Tan & Solah, 2022). Collectively, these factors suggest that military driving safety transcends individual behavioral considerations and constitutes a systemic operational vulnerability necessitating comprehensive preventative interventions.

Despite the growing interest in military driving behaviour, the existing literature remains fragmented, under-theorised, and predominantly centred on Western contexts, with insufficient cross-disciplinary integration of findings. To date, scientometric analysis has not been applied in this field, leading to a limited understanding of research trends, influential contributors, and underexplored themes. Furthermore, there is a conspicuous lack of scoping reviews that map behavioural models, contextual factors, and intervention studies. Consequently, this dual-method review is essential for synthesising existing knowledge, identifying thematic gaps, and guiding future research and policy development to enhance driving safety and operational effectiveness in military environments.

METHOD AND ANALYSIS DESIGN

Scientometric Analysis

Scientometric analysis is a widely recognised method for examining and understanding extensive scientific datasets. This approach facilitates a more nuanced comprehension of growth within specific domains (Donthu et al., 2021). The utilisation of scientometric indicators to evaluate the quality of research output is increasingly prevalent. Researchers employ scientometric analysis for a variety of purposes, including

the identification of emerging trends and the assessment of journal performance (Struck et al., 2021). It is further utilised to investigate collaboration patterns, discern significant research components (Wachsmann et al., 2019), analyse trends in publications within particular fields (Abdullah, 2021), and explore the intellectual structure of disciplines through published works (Simao et al., 2021). In this study, we apply scientometric analysis to identify trends in research papers pertaining to driving behaviour in the context of military environment, determine the nations that are actively contributing to this field, and examine the themes and subthemes reflected in authors' keywords.

Scoping Analysis

The primary objective of scoping reviews is to systematically collect and document a diverse range of available evidence (Munn et al., 2018). Therefore, this study aims to conduct a comprehensive analysis of the critical aspects related to driving behaviour in the context of military environment literature and to synthesise the existing research in this area. This scoping review has been undertaken to identify areas that require further exploration and to highlight gaps in the current body of knowledge. The study followed the established five-step scoping review framework developed by Arksey and O'Malley.

1) Setting up the research question.
2) Finding studies that are useful.
3) Choosing studies.
4) Making charts of data.
5) Reporting the outcomes.

Formulating Research Inquiry

This study's scope analysis is based on the following research question, "what are the key findings from the current research concerning driving behaviour in military personnel?"

Identifying Relevant Studies

Database

Identifying scholarly articles in scientific journals, institutional repositories, archives, and various resource collections necessitates the utilisation of databases and search engines (Abdullah et al., 2020). This study employed the Scopus and Web of Science (WoS) databases to investigate scientometric and scoping indicators. These databases were selected due to their emphasis on document citations in comparison to other databases (Vieira & Gomes, 2009). The coverage analysis was augmented through enhanced metadata, document categorisation, and appropriate disciplinary assignments. Consequently, Scopus and WoS attribute greater significance to these factors (Stahlschmidt & Stephen, 2022).

Search Strategy

Once the core keywords were identified, relevant synonymous terms were derived using an academic encyclopedia to ensure broader conceptual coverage. These terms were subsequently organised into unified search strings employing Boolean operators (e.g., AND, OR) to optimise both precision and recall. The same search strings were consistently applied in the Scopus and WoS databases to maintain methodological comparability. Searches were conducted across the Title, Abstract, and Keyword fields, ensuring the inclusion of publications that referenced the relevant concepts without limitation by subject area or

disciplinary domain. Importantly, no filters or restrictions were applied in either database, including unrestricted parameters for publication year, document type, and language, in order to maximise the comprehensiveness of the initial dataset. The entire search was conducted in October 2025, and the search strings used in both databases are presented in Table 1 for the purposes of transparency and replication.

Table 1

Methodology for retrieving information from Scopus and the Web of Science.

Database	Search Strategy	Records
Web of Science	Topic:("driving behavior" OR "driving performance" OR "driving patterns" OR "driver decision-making" OR "driving style" OR "on-road behaviour" OR "driving habits" OR "Driving ethics") AND ("military" OR "defense forces" OR "armed forces" OR "combat" OR "navy" OR "army" OR "special forces" OR "soldier" OR "soldiers" OR "cadet" OR "private soldier")	62
Scopus	Article Title, Abstract, Keywords: ("driving behavior" OR "driving performance" OR "driving patterns" OR "driver decision-making" OR "driving style" OR "on-road behaviour" OR "driving habits" OR "Driving ethics") AND ("military" OR "defense forces" OR "armed forces" OR "combat" OR "navy" OR "army" OR "special forces" OR "soldier" OR "soldiers" OR "cadet" OR "private soldier")	167

Software

ScientoPy and VOSviewer are two widely used tools in bibliometric and scientometric research. ScientoPy, a Python-based script, extracts structured information from bibliographic databases, including primary research topics, authorship patterns, country affiliations, and associated documents, using author-supplied metadata such as keywords and titles (Ruiz-Rosero et al., 2017). This tool helps mitigate the selection bias often introduced by isolated manual searches; however, it has limitations in assessing the substantive relevance of documents. Therefore, in this study, a manual screening process was conducted after the initial data extraction. Articles were manually reviewed based on their titles, abstracts, and keywords to ensure their topical relevance to driving behaviour in a military context, addressing ScientoPy's limitations in filtering out conceptually off-topic entries. Furthermore, while ScientoPy can identify theories cited in metadata fields, it cannot detect those mentioned only in full texts, suggesting that theoretical gaps may persist in such analyses (Radzi et al., 2025a).

VOSviewer, developed by Van Eck and Waltman (2010), was employed to perform co-occurrence analyses of keywords. It transforms bibliographic CSV data into visual maps that identify thematic clusters and intellectual linkages (Abdullah, 2022). These keyword maps were particularly useful for identifying high-frequency terms and conceptual groupings (Abdullah & Othman, 2022; Radzi et al., 2024). However, to complement these automated outputs, a manual thematic analysis was also conducted using article titles, abstracts, and keywords. Themes were generated through inductive coding, initially carried out by one reviewer and then cross-checked by a second reviewer to enhance reliability and reduce subjective bias. While the study did not employ a formal intercoder reliability coefficient, any disagreements were resolved through discussion. Future studies may consider using a fully data-driven method, such as co-word analysis, to improve the objectivity and replicability of thematic interpretation.

Selecting Studies: Publications Merge and Removal of Duplicates

The information from both databases was aggregated and analyzed via ScientoPy. At this point, we normalized the data by substituting commas in authors' names with semicolons, removing periods and distinctive formatting, and eradicating duplicate entries with identical titles and authors. This

methodological approach seeks to improve the precision and dependability of the datasets. Figure 1 illustrates the outcomes of the preprocessed data.
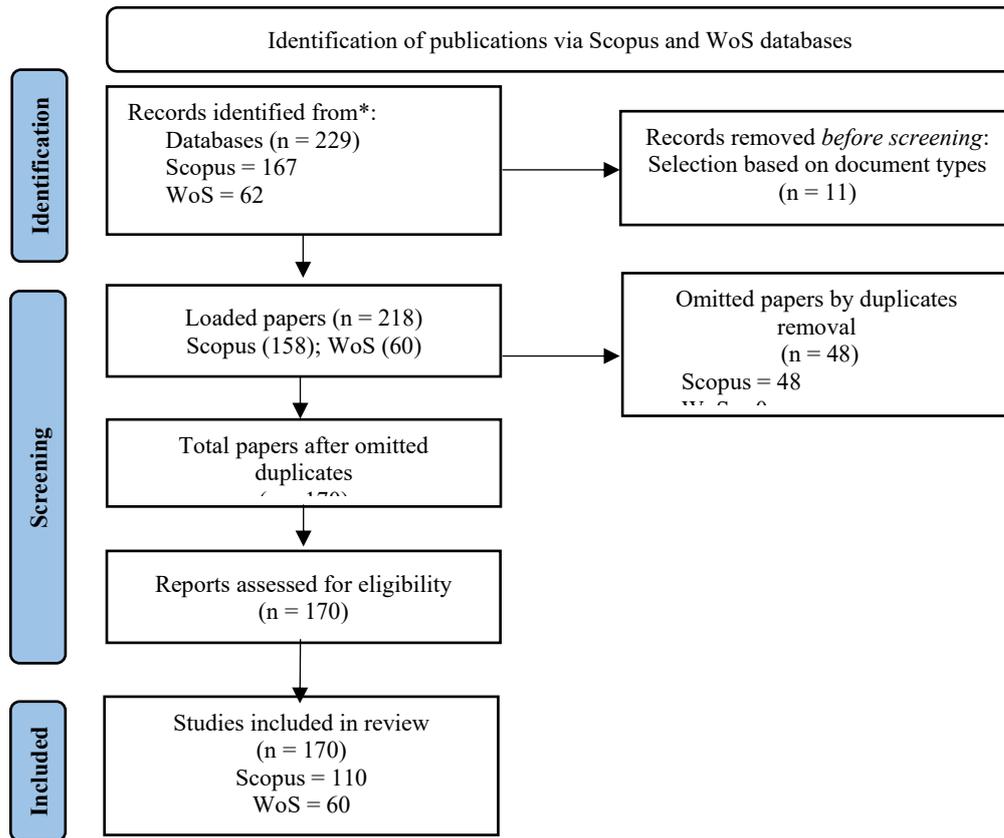
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┌─────────────────────────────────────────────────────────────┐
│   Identification of publications via Scopus and WoS databases │
└─────────────────────────────────────────────────────────────┘
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Identification

Records identified from*:
Databases (n = 229)
Scopus = 167
WoS = 62

→ Records removed *before screening*:
Selection based on document types
(n = 11)

Screening

Loaded papers (n = 218)
Scopus (158); WoS (60)

→ Omitted papers by duplicates removal
(n = 48)
Scopus = 48

Total papers after omitted duplicates

Reports assessed for eligibility
(n = 170)

Included

Studies included in review
(n = 170)
Scopus = 110
WoS = 60

Figure 1
Flow diagram of research of databases and registers

The preprocessing script utilised in ScientoPy preferentially selects documents sourced from the WoS over those from Scopus. Diagram 1 illustrates that the source dataset comprises 229 papers obtained from the WoS and Scopus databases. ScientoPy systematically categorises these publications into distinct classifications, including conference papers, articles, reviews, proceedings papers, and press releases. Consequently, 11 items, encompassing books, letters, and errata, were excluded from the analysis. Following data reconciliation, this study incorporated a total of 170 entries from both databases, consisting of 60papers from WoS and 110 from Scopus. Furthermore, 48 duplicate entries exclusively from Scopus were removed.

Data Charting

The publication growth graph illustrates the evolution of publishing within the Scopus and WoS databases, which is crucial for understanding overall publication patterns. To enhance our analysis of the previously selected articles, we will examine the evolution graph of the top 10 authors' keywords and evaluate the co-occurrence of these keywords.

Reporting Results

In alignment with the objectives of the study, a succinct summary and report of the findings were prepared. ScientoPy was utilized to analyze publication growth, identify active countries, and examine keywords. VOSviewer functioned as a descriptive tool to assess the co-occurrence of authors' keywords. It is noteworthy that a minimum of two keywords is necessary to generate co-occurrence results for authors' keywords in VOSviewer. Furthermore, the thesaurus files were meticulously reviewed and modified in accordance with the recommendations of Abdullah et al. (2022) to prevent duplication of authors' keywords.

This study utilizes a scoping review methodology, aimed at providing a thorough overview of the current research landscape within a defined area. The primary aim of performing a scoping study is to pinpoint gaps or shortcomings in the existing literature. This investigation systematically examines and characterizes the current state of research on driving behavior in military context, while also identifying areas where the literature lacks depth. In order to conduct this analysis, articles obtained from Scopus and WoS underwent preprocessing with ScientoPy. The inclusion criteria for this scoping review are outlined in Table 2.

1) Written in English.
2) Publications within 2015-2025.
3) Describe primary research.
4) Use the keyword intervention in the authors keywords.

Publication Growth

Figure 2 illustrates the growth of publications pertaining to driving behaviour in a military context, comparing outputs indexed in Scopus and Web of Science (WoS) from 1990 to 2025. Both databases demonstrate a clear upward trend commencing around 2005, with Scopus exhibiting a sharper and more sustained increase in publications, particularly between 2015 and 2025, when the number of documents peaked at 10 per year. This trend indicates an escalating scholarly interest and a broader indexing of the subject matter. In contrast, WoS data reveals more sporadic and lower-volume outputs, with a notable peak in 2015, subsequently followed by fluctuating activity. This suggests that while research in this domain is expanding, much of it may be concentrated in specific journals or regions that are better represented in Scopus, thereby highlighting potential indexing or disciplinary biases.

The growing body of research on military driving behaviour emphasises its crucial impact on operational safety and mission effectiveness, highlighting the need to consider human factors in high-risk environments. Sleep deprivation, common among military personnel due to occupational and psychosocial stressors, has been linked to high-risk behaviours such as reckless driving. This suggests that improving sleep quality and duration could help mitigate these behaviours (Mantua et al., 2021). Moreover, aggressive driving, a significant issue among veterans, is worsened by conditions like PTSD—whether or not accompanied by traumatic brain injury—underscoring the need for targeted interventions that manage emotional and physiological arousal (Voorhees et al., 2018). The impact of road safety policies and individual characteristics, such as holding a driver's licence and having a history of past violations, also influences risky driving behaviours. This indicates that community involvement and policy support may aid in reducing unsafe actions (Jomnonkwao et al., 2022). Additionally, the relationship between average speed and crash likelihood is complex, with driver-related factors such as distracted driving and tailgating mediating the effects of speed on crash risk. This highlights the importance of understanding these dynamics to improve safety outcomes (Nassiri & Mohammadpour, 2023). Collectively, these studies illustrate the multifaceted nature of military driving behaviour and the necessity for comprehensive

strategies that address sleep, psychological health, policy, and environmental factors to enhance safety and mission success.
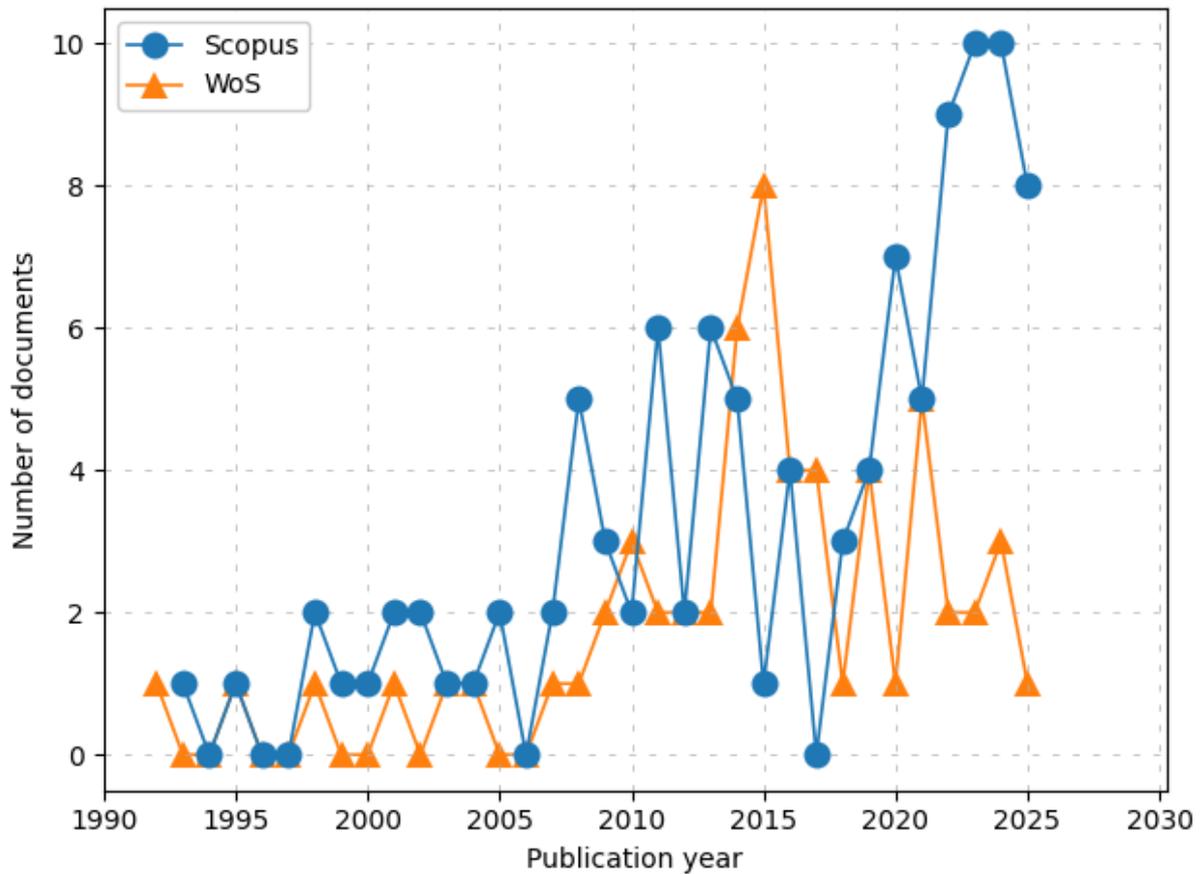

Figure 2
The evolution of publication growth (Source: Author, using ScientoPy 2.1.3)

The Most Influential Academic Works

Figure 3 illustrates the most influential academic institutions contributing to research on driving behaviour within a military context, as indicated by the total number of documents and recent output from 2024 to 2025. Notably, the majority of leading institutions, particularly those from the United States, South Korea, China, Canada, Iran, and Hong Kong, have produced limited yet foundational work, with all but one institution indicating 0% of their publications occurring in the last two years. Carnegie Mellon University distinguishes itself as the sole institution exhibiting recent scholarly activity, with 50% of its output published between 2024 and 2025. This observation suggests a renewed or emerging research focus in this domain. Conversely, the absence of recent publications from other institutions may indicate a potential stagnation or restricted distribution of research efforts, underscoring the necessity for broader academic engagement and sustained investigation on a global scale.
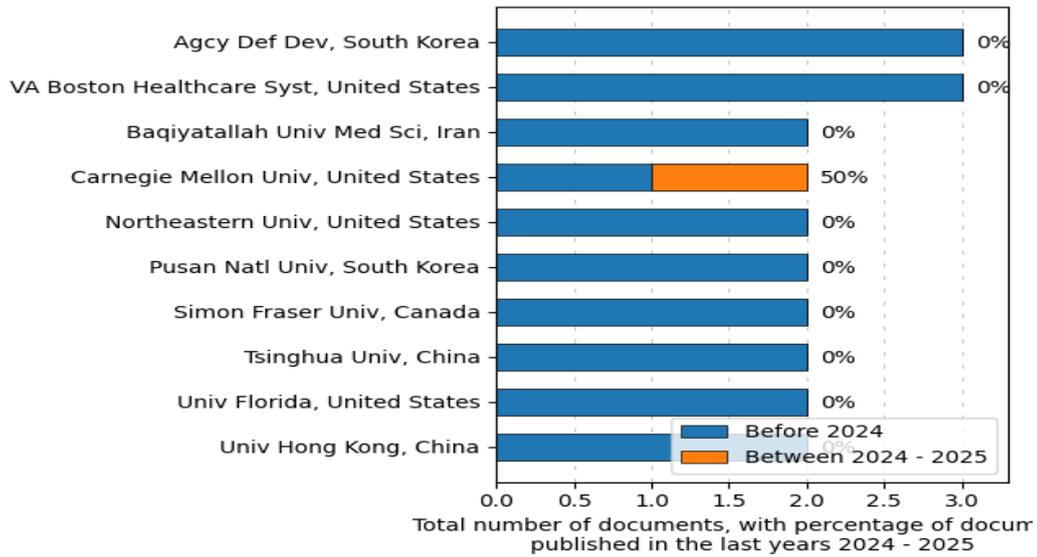
Figure 3

Institution Bar Trends Graph

Authors' Keywords

Figure 4 illustrates the most frequently utilised authors' keywords and research themes in publications pertaining to driving behaviour within a military context. It emphasises both the thematic focus and the temporal distribution of research efforts. "Driving behaviour" emerges as the predominant keyword, underscoring its status as the central focus of scholarly inquiry, with 14% of relevant documents published between 2024 and 2025, reflecting a sustained interest in this area. Although other significant themes, such as "driving performance," "veterans," "driving simulator," and "traumatic brain injury," are present, they exhibit no recent research activity, suggesting stagnation within these subfields. Conversely, the term "intervention" demonstrates notable recent growth, accounting for 33% of its usage in 2024-2025. This shift indicates a transition towards applied, solution-oriented research and a growing recognition of the necessity for evidence-based strategies to enhance driver safety and performance in military environments.
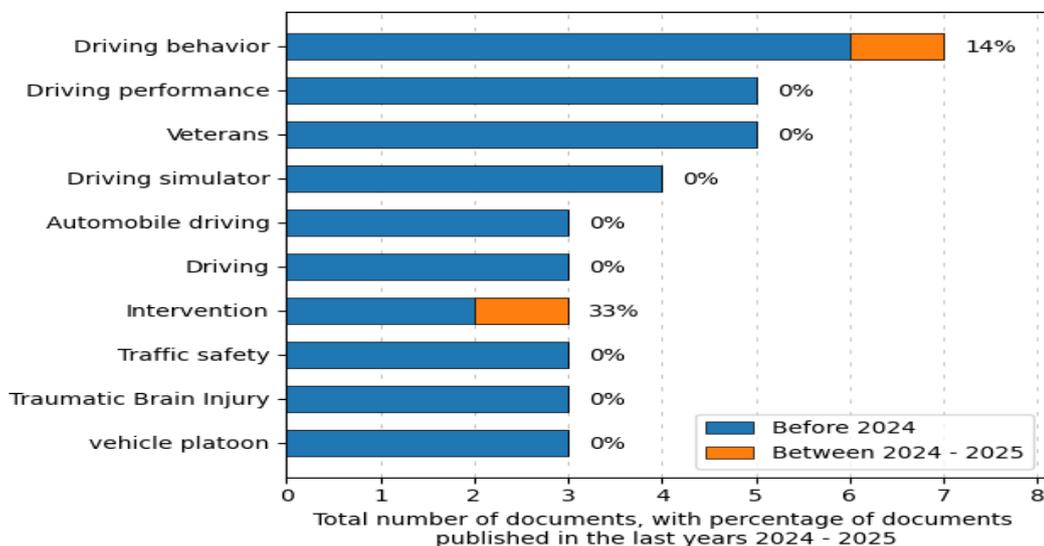

Figure 4

The bar-trend graph of research themes and topics emerging (Source: Author, using ScientoPy 2.1.3)

Figure 5 presents a visualisation using VOSviewer to illustrate the evolution and clustering of authors' keywords related to driving behaviour within a military context, revealing four primary research themes with limited interconnection. The terms "driving simulator" and "driving performance" are closely linked and emerged earlier in the research timeline (approximately 2013–2015), reflecting a methodological emphasis on experimental assessments and skill-based evaluations of military drivers. In contrast, "driving behaviour" emerged more recently (circa 2017–2018) as an independent theme that highlights human factors, decision-making, and behavioural risk assessment. Meanwhile, the isolated positioning of "veterans" suggests a niche but growing area focused on post-service driving challenges, including the cognitive or psychological effects of deployment. The sparse network and weak linkages among keywords indicate that, although the field is progressing, research remains fragmented. This fragmentation calls for greater thematic integration to bridge simulator-based studies, behavioural analysis, and veteran-related outcomes in future investigations.
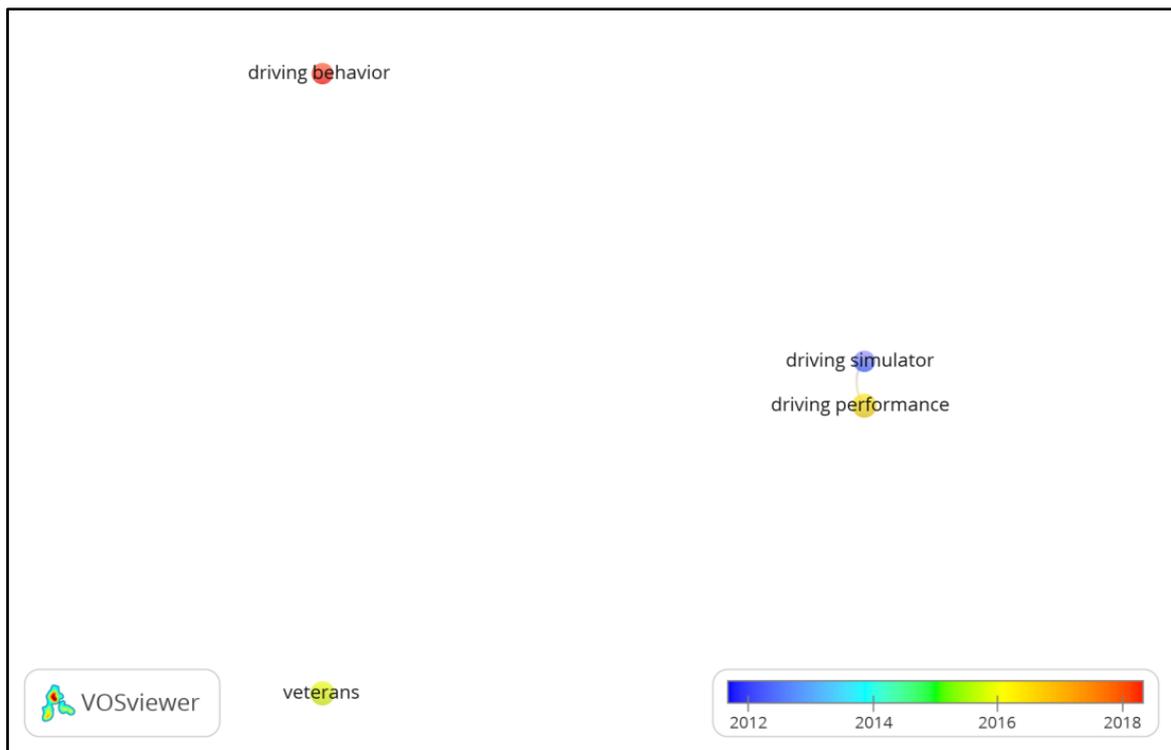

Figure 5
Co-occurrence of authors' keywords

Foundational Theories

Figure 6 underscores the limited theoretical foundation of research on driving behaviour within a military context, indicating that only two foundational theories, such as game theory and molecular dynamics theory, have been referenced, with no publications recorded between 2024 and 2025. This scarcity suggests that the majority of studies in this domain lack explicit theoretical frameworks to elucidate or predict driver decision-making, coordination, and performance under operational stress. The incorporation of game theory implies initial attempts to model competitive or strategic decision-making among drivers in convoy or combat scenarios, whereas molecular dynamics theory likely pertains to efforts to simulate micro-level interactions within vehicle systems rather than behavioural phenomena. Overall, the absence of more contemporary or psychologically grounded theories, such as human factors or behavioural decision

models, highlights a substantial conceptual gap that future research must address to enhance understanding and improve the scientific rigour of studies on military driving behaviour.
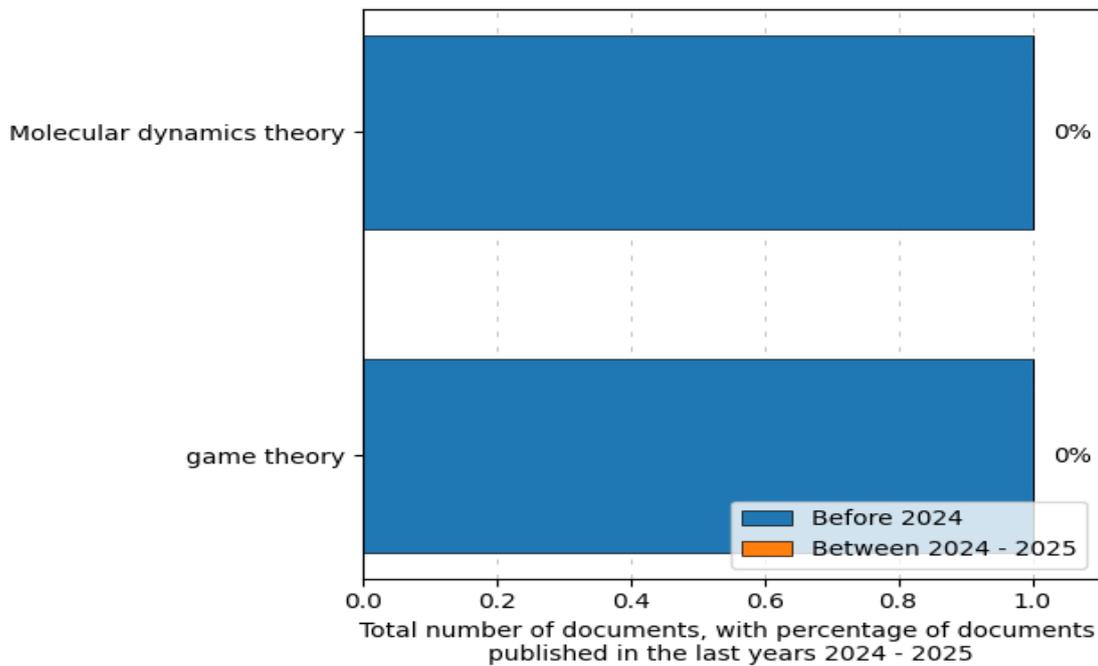

Figure 6
The bar-trend graph of foundational theories (Source: Author, using ScientoPy 2.1.3).

Scoping Outcomes

This section provides a detailed analysis of the discourse surrounding "intervention" in literature related to driving behaviour in a military context. This examination is a crucial first step in identifying gaps in understanding and guiding future research initiatives, thereby enhancing the existing body of knowledge and established practices. The scoping analysis involved formulating qualitative research questions, and the SPIDER tool was used as the search strategy for this study. Table 2 offers a comprehensive compilation of publications based on extended author keywords sourced from ScientoPy. The data in Table 2 is derived from an analysis of three documents, with the study specifically focusing on the scoping analysis of research articles.

Table 2
List of Inclusive Publications

No	Sources	Sample	Phenomenon of Interest	Design	Evaluation	Research Type
1.	Monaci et al., (2025)	The review analyzed 23 studies published between 2010 and 2024, with most (83%) appearing after 2018, indicating growing recent interest in the topic	Investigates the effectiveness of digital educational interventions within Antimicrobial Stewardship Programs in enhancing knowledge and behavior change to	Employed a systematic review design following JBI and PRISMA guidelines, registered in PROSPERO, and conducted a comprehensive	Digital educational Antimicrobial Stewardship Programs were largely effective, showing notable reductions in inappropriate	Review

			address the global challenge of antimicrobial resistance	search across PubMed, Web of Science, Scopus, and CINAHL databases	prescribing and improvements in knowledge, though few studies applied theoretical frameworks, rigorous designs, or long-term follow-ups	
2.	Nazari et al., (2017)	Included participants from 18 studies representing diverse populations and contexts within drowsy driving research	Evaluating interventions aimed at reducing driver fatigue and sleepiness, major factors responsible for 20–30% of all road traffic accidents and fatalities	Synthesized findings from 18 eligible studies out of 63 identified, examining the effectiveness of interventions to reduce fatigue- and drowsiness-related accidents using primarily cross-sectional and interventional designs, with one meta-analysis on Obstructive Sleep Apnea Syndrome	Identified behavioral, environmental, and educational interventions used globally to reduce driver drowsiness, but due to methodological heterogeneity, it could not determine precise effect sizes, highlighting the need for further comparative and context-specific research	Review
3.	Gidron et al., (2015)	The three studies involved distinct participant groups: 59 Belgian management students (mostly female, mean age 21.2), 53 Israeli police cadets (mostly male, mean age 31.1, with 7.7 years of driving experience), and 40 male university students from Brussels, with women excluded due to gender differences in accident involvement	Examines road hostility as a stable antagonistic trait influencing dangerous driving and traffic accidents, while evaluating psychological inoculation as an intervention to correct cognitive distortions and enhance social resistance to hostile driving behaviors	Across three experimental studies, the research compared psychological inoculation with control conditions such as safety education or awareness campaigns, measuring changes in road hostility and simulated driving behavior before and after the interventions	Across three studies, psychological inoculation proved more effective than traditional education or awareness campaigns by significantly reducing road hostility and improving simulated driving outcomes—particularly accident reduction and safer vehicle control—though its effects on speeding and	Quantitative

long-term sustainability were limited

DISCUSSION

The findings of this study reveal a complex interplay among psychological, environmental, and operational factors that collectively influence driving behaviour, risk-taking, and safety outcomes within military contexts. The research highlights how stress, fatigue, mental health, and situational demands interact to affect driver performance and the likelihood of accidents. Stress and fatigue are particularly critical, as evidenced by the detrimental effects of job stress and fatigue on long-haul truck drivers, which mediate the relationship between stress and traffic crashes (Radzi et al., 2025c). This underscores the need for interventions aimed at managing stress and fatigue (Useche et al., 2021). In military settings, sleep health is also vital; it enhances team dynamics and social processes, ultimately improving operational health, performance, and safety (Roma et al., 2022). Mental health issues, such as post-traumatic stress disorder (PTSD), are significant, with PTSD either alone or in combination with traumatic brain injury (TBI) substantially increasing the risk of aggressive driving among veterans. This suggests the importance of addressing hostile interpretation biases and improving emotional regulation (Voorhees et al., 2018). Additionally, risky driving behaviours are frequently linked to other health-compromising behaviours and mental health factors, particularly in late adolescents, highlighting the need for targeted interventions during driving training (McDonald et al., 2014). Physical inactivity also contributes, as it can exacerbate stress, fatigue, and health issues, thereby increasing the risk of road traffic accidents among professional drivers (Taylor & Dorn, 2006).Overall, these findings emphasise the necessity of comprehensive strategies that address psychological, environmental, and operational factors to enhance driver performance and reduce the likelihood of accidents in military and similar high-stress environments.

The topic of driving behaviour holds significant academic interest and warrants further exploration, particularly within a military context. Persuasive in vehicle technology has been proposed to influence tactical driving behaviours, such as lane-changing, without compromising safety. This could be especially beneficial in military settings, where strategic manoeuvring is crucial (Gent et al., 2019). The impact of psychological conditions, such as PTSD and TBI, on driving behaviour is substantial among veterans. PTSD, particularly when co-occurring with TBI, has been linked to increased aggressive driving and road rage (Voorhees et al., 2018). This highlights the need for targeted interventions to manage emotional and physiological arousal in military personnel (Radzi, 2024). Moreover, stress and emotional states have been shown to influence driving decisions, such as gap acceptance at intersections, with heightened stress levels leading to riskier driving choices (Paschalidis et al., 2018). This is particularly relevant in high-pressure military operations, where stress is prevalent. Additionally, the use of physiological measures such as EEG and heart rate can enhance the understanding of driver intentions and behaviours, offering potential for real-time monitoring and intervention in military vehicles (Li et al., 2022). The unique challenges faced by individuals with high-functioning autism, such as altered visual attention patterns under cognitive load, further underscore the need for tailored driving support systems in diverse military populations (Reimer et al., 2013). Collectively, these studies emphasise the importance of integrating psychological insights and technological advancements to improve driving safety and performance in military contexts.

To gain a deeper understanding of how military environments influence driving behaviour, it is crucial to examine how extreme operational stress impacts the cognitive, emotional, and neurobiological responses of deployed service members and young military drivers. These mechanisms significantly alter perception, decision-making, and overall driving performance in high-risk operational settings. Acute stress reactions (ASRs) are common in military contexts and can impair safety and performance, highlighting the need for

effective interventions, such as a stepped care approach, to manage these reactions (Matson et al., 2022). Sleep deprivation, which is prevalent among military personnel due to operational demands, further exacerbates risky behaviours, including reckless driving, by impairing decision-making processes. Poor sleep quality and short sleep duration are linked to an increase in high-risk behaviours, suggesting that improving sleep could help mitigate these risks (Mantua et al., 2021). Stress-induced neurobiological changes, particularly in the hippocampus and prefrontal cortex, complicate cognitive functions such as memory and decision-making, potentially leading to maladaptive behaviours (Palamarchuk & Vaillancourt, 2021; Kühn et al., 2021). These structural brain changes, especially in the anterior cingulate cortex and ventromedial prefrontal cortex, are associated with trauma exposure and may persist beyond deployment, indicating long-term implications for mental health and behaviour (Kühn et al., 2021). Moreover, acute threats can enhance perceptual sensitivity, which may affect driving performance by altering how service members process sensory information under stress (Voogd et al., 2022). Collectively, these factors underscore the complex ways in which military environments shape driving behaviour, emphasising the need for targeted interventions to address stress, sleep, and neurobiological health within military populations.

Game theory provides a foundational perspective on strategic and competitive decision-making processes among military personnel, particularly in high-stress operational environments. It models interactions as games, where the outcome for each participant depends on the decisions made by others. This framework assumes that decision-makers are rational and self-interested; however, research indicates that group decisions tend to align more closely with these assumptions than individual decisions. This suggests that game theory may serve as a more accurate model for group dynamics in military contexts (Kugler et al., 2012). Nonetheless, human behaviour in strategic settings is influenced by a variety of social and psychological factors, which can lead to deviations from game-theoretic predictions. This is particularly evident in human-agent interactions, where automated agents designed based on game-theoretic strategies must account for human unpredictability to engage effectively (Kraus, 2015). In multi-agent environments, strategic uncertainty arises, necessitating robust decision-making approaches that consider the rationality levels and planning horizons of agents, as these factors can significantly affect coordination and risk-taking behaviours (Łatek & Rizi, 2011). Moreover, human group coordination can be examined through experiments and simulations, which reveal that nonspecific, information-based strategies can lead to effective coordination. However, reinforcement learning approaches may not fully encompass human behaviour (Hornischer et al., 2022). Additionally, the concept of multichannel games illustrates how strategic decisions in one context can influence those in another, fostering cooperation across different interactions. This is particularly important in convoy or combat situations, where multiple strategic considerations must be addressed simultaneously (Donahue et al., 2020). These insights underscore the complexity of military decision-making and the necessity of integrating game theory with other theoretical frameworks to enhance our understanding and prediction of behaviours in high-stress operational settings.

A scoping analysis indicates that three studies have been published in journals indexed by Scopus and WoS from 2015 to 2025, focusing on interventions aimed at improving driving behaviour in military environments. The exploration of various strategies to enhance safety-related driving behaviours highlights a range of effective methods, particularly psychological and educational approaches, despite some methodological and theoretical limitations. For medically at-risk older drivers, interventions such as graded simulator training and multimodal traffic theory education have received strong recommendations for improving driving safety, particularly for individuals with stroke or visual deficits (Classen et al., 2014). The application of the prototype willingness model (PWM) emphasises the importance of psychological factors, such as behavioural willingness and prototype perceptions, in influencing speeding behaviour. This suggests that interventions targeting these psychological constructs can effectively modify driving

behaviours (Elliott et al., 2017). Educational programmes, such as the Slovenian initiative "I still drive, but I cannot walk," have demonstrated a significant reduction in the correlation between violations and accidents, indicating the potential of educational interventions to mitigate risky driving behaviours (Topolšek et al., 2019). Additionally, gamification has emerged as a promising tool in transportation, effectively changing travel behaviour and promoting safe driving through elements such as goals and challenges, although it faces implementation challenges (Wang et al., 2022). Collectively, these studies underscore the efficacy of psychological and educational interventions in enhancing driving safety while also highlighting the need for further research to address existing limitations and optimise these strategies.

The primary phenomena of interest identified the effectiveness of digital educational, behavioural, and psychological interventions in improving driving-related behaviours, such as reducing fatigue, sleepiness, and road hostility. These interventions are aligned with the objective of understanding and enhancing military driving behaviour through evidence-based strategies that address cognitive, emotional, and behavioural risk factors in high-stress operational contexts. Sleep quality and duration are critical factors influencing risky driving behaviours, as demonstrated by a mega-analysis of U.S. Army units, which found that poor sleep quality and shorter sleep duration increased the likelihood of high-risk behaviours, including reckless driving (Mantua et al., 2021). Similarly, young drivers who continue to drive while sleepy are more prone to engage in risky driving behaviours, highlighting the need for interventions targeting sleep-related factors (Watling, 2020). The iREST platform, a mobile health tool providing just-in-time adaptive interventions, has proven effective in improving sleep quality and reducing insomnia severity among military personnel, suggesting its potential to mitigate driving-related risks associated with sleep disturbances (Pulantara et al., 2018). Behavioural interventions, which target cognitive and social mechanisms, can have ripple effects on various health outcomes, including driving behaviours, by addressing underlying emotional and cognitive risk factors (Wilson, 2015). Additionally, aggressive driving, exacerbated by stressors such as the COVID-19 pandemic, underscores the importance of interventions that focus on changing road culture and improving interactions among drivers to reduce hostility and aggression on the roads (Stephens et al., 2022). Collectively, these findings support the implementation of evidence-based digital interventions to enhance military driving behaviour by addressing cognitive, emotional, and behavioural risk factors in high-stress environments.

The findings collectively underscore the alignment with Sustainable Development Goal 8 (SDG 8) by highlighting the importance of improving military driving behaviour through psychological, educational, and technological interventions. These enhancements contribute to operational safety and a reduction in non-battle injuries. Vladimir et al. (2021) and Radzi et al. (2025b) emphasise the role of psychological preparation in ensuring road transport safety, advocating for a comprehensive approach to driver suitability assessment that could be applied within military contexts to enhance safety and minimise accidents. Whipple et al. (2016) concentrate on the unique challenges encountered by veterans with comorbid TBI and PTSD, identifying high-risk driving behaviours and anxiety as critical areas for intervention. This insight may inform targeted strategies aimed at improving safety and well-being among military personnel. The Occupational Safety and Health Staging Framework presented by Schulte et al. (2022) provides a broader context for understanding how occupational safety and health initiatives contribute to decent work. It underscores the necessity for frameworks that address emerging risks and promote worker well-being (Ismail et al., 2024), which is essential for sustainable productivity in military settings. Sheriff et al. (2015) document a reduction in risky driving behaviours among UK military personnel, attributing this improvement to effective road safety campaigns, thereby highlighting the potential of educational interventions to promote safer driving practices. Finally, Wu et al. (2023) demonstrate the effectiveness of cognitive interventions in reducing aggressive driving behaviours, suggesting that similar strategies could be adapted for military drivers to enhance safety and operational efficiency. Collectively, these studies

illustrate that improving driving behaviour through various interventions not only enhances safety but also contributes to the overall well-being and resilience of military personnel, thereby supporting sustainable economic growth and human capital development.

CONCLUSION

This study synthesised the extant literature on military driving behaviour through a convergent scientometric and scoping review, providing an overview of research trends, theoretical underpinnings, and intervention approaches germane to this domain. The scientometric analysis indicates a gradual increase in scholarly output since 2005, with heightened research attention observed post-2015, particularly in relation to driver performance, fatigue, veteran driving outcomes, and safety interventions. Nevertheless, the findings suggest that the field remains fragmented and conceptually circumscribed, with only game theory and molecular dynamics theory explicitly identified as foundational frameworks, and limited incorporation of behavioural or human factors perspectives. The scoping review further identified digital educational, behavioural, and psychological interventions as the predominant strategies examined, with evidence suggesting improvements in select safety-related outcomes, including fatigue, sleepiness, road hostility, and crash risk; however, the robustness of these conclusions is attenuated by methodological heterogeneity, a paucity of intervention studies, and limited longitudinal evaluation. Collectively, these findings underscore the need for more theoretically grounded and methodologically rigorous research to elucidate driver decision-making and performance under military operational conditions. From an applied standpoint, the review offers preliminary guidance for developing evidence-informed safety initiatives that may contribute to improved occupational safety, reduced non-battle injuries, and enhanced operational effectiveness. In so doing, the study offers a circumspect contribution to Sustainable Development Goal 8 (Decent Work and Economic Growth) by situating military driving behaviour within broader considerations of workforce safety, human capital preservation, and organisational productivity.

Contribution to the Body of Knowledge

This study contributes to the existing body of knowledge by integrating scientometric and scoping analyses to systematically map, synthesise, and evaluate global research on military driving behaviour. It reveals fragmented theoretical foundations and highlights the increasing emphasis on psychological, behavioural, and educational interventions aimed at improving safety and performance. Practically, this research advances the field by identifying critical research gaps, particularly the absence of contemporary behavioural theories and long-term evaluations. Consequently, it provides a structured foundation for future studies and evidence-based practices designed to enhance operational safety, resilience, and human performance in military driving environments.

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