

Awareness of CO₂ Emission by Cars and Eco-Friendly Environment in the Malaysian Automotive Industry: A Study on Drivers' Perspectives

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Abstract

This study examines drivers' knowledge of CO₂ emissions and the eco-friendly environment in the Malaysian automotive industry. In the context of vehicle use and the carbon emissions it causes, it is essential to comprehend people's understanding and perception of their activities' influence on the environment. This study used a survey approach to learn about drivers' knowledge of automobile CO₂ emissions and their damaging environmental effects. The study will collect data from a broad cross-section of Malaysian drivers. Drivers' knowledge of the effects of CO₂ emissions on the environment, their feelings about the earth's future, and their openness to adopting eco-friendly driving habits will be determined using descriptive analysis and statistical methods like PLS-SEM. It also investigates the moderating effect of demographics on the link between awareness of CO₂ emissions and environmentally responsible driving. This study's results facilitate understanding the present level of knowledge among Malaysian drivers about CO₂ emissions and the eco-friendly environment. This study aims to aid policymakers, industry stakeholders, and environmental organizations in developing targeted interventions and initiatives to promote sustainable practices in the automotive sector by examining the relationships between awareness, demographic factors, and drivers' perceptions.

Keywords: CO₂ Emission, Awareness, Eco-friendly, Malaysia, Automotive

Introduction

The importance of carbon dioxide (CO₂) emissions from vehicles in the occurrence of global warming has been demonstrated, according to research by (Cioca et al., 2019). Furthermore, sustainability standards have recognized the automobile industry as a notable source of CO₂ emissions. Therefore, the automotive sector must comprehend the extent of awareness among Malaysian drivers concerning CO₂ emissions and sustainable ecosystems. Understanding CO₂ emissions from vehicles and their environmental consequences is imperative to advance sustainability efforts and safeguard the environment (Yusliza et al., 2020). Kontovas (2020) provides corroborating evidence by asserting that carbon dioxide emissions into the Earth's atmosphere are causally linked to global warming, climate change, and air pollution.

Efforts are underway to foster a sustainable automotive industry in Malaysia, focusing on developing environmentally friendly approaches to mitigate carbon emissions. A comprehensive comprehension of the immediate ramifications of drivers' behaviors and their proactive efforts to mitigate carbon dioxide emissions is paramount. According to Jin (2022), successfully implementing these initiatives relies heavily on drivers' active participation and awareness. Hence, it is imperative to assess the level of environmental and carbon dioxide awareness among drivers in Malaysia. This assessment aims to identify and address specific challenges by developing appropriate solutions.

By studying drivers' comprehension of CO₂ emissions and their commitment to environmental sustainability, we can holistically formulate efficacious approaches to improve ecological well-being. However, it is necessary to increase awareness regarding the environmental impacts of carbon dioxide (CO₂) emissions from vehicles to promote and advance initiatives for environmentally friendly transportation. Therefore, it is imperative to offer drivers a comprehensive education regarding the environmental ramifications of carbon dioxide (CO₂) emissions. Implementing this educational initiative is crucial for addressing the current disparity in knowledge (Adu-Gyamfi et al., 2022).

Malik (2020) posits that the cultivation of environmental consciousness and knowledge has the potential to exert a favorable impact on individuals' conduct, fostering the adoption of sustainable behaviors. This study aims to investigate the level of drivers' comprehension regarding the environmental consequences associated with carbon dioxide (CO₂) emissions, their attitudes toward the concept of sustainable environments, and their inclination to adopt eco-friendly driving practices. Additionally, this research investigates how demographic variables, including age, gender, and marital status, may influence the relationship between CO₂ emission consciousness and eco-friendly driving habits. Yusliza et al (2020) and Ong et al. (2021) have identified the promotion of awareness and the cultivation of responsible driving as potential strategies for augmenting the sustainability of Malaysia's automotive industry.

Literature Review*CO₂ Emissions from Cars*

The government of Malaysia has set a goal of reducing greenhouse gas emissions by 45 percent from 2005 levels by the year 2030. The transportation sector in Malaysia holds significant importance in contributing to the country's overall emissions of greenhouse gases.

However, it may be necessary for the current initiatives to lessen these emissions more effectively (Fontaras, 2017). Malaysia must adopt transportation development strategies emphasizing environmental responsibility and friendliness to achieve its sustainability goals (Shahid, 2014). In 2018, Malaysia witnessed a notable surge in carbon dioxide emissions, reaching 257.8 million tons. This figure indicates a substantial rise of 122.9 million tons compared to the emissions recorded in 1999. This figure corresponds to an approximate annual growth rate of 4.49%.

(Refer to Table 1).

Table 1

Malaysia CO₂ Emissions

| YEAR | VALUE | CHANGE, % |
|------|-------|-----------|
| 2018 | 257.8 | 4.49 % |
| 2017 | 246.8 | 0.16 % |
| 2016 | 246.4 | -1.29 % |
| 2015 | 249.6 | 0.02 % |
| 2014 | 249.5 | 5.42 % |
| 2013 | 236.7 | 7.76 % |
| 2012 | 219.7 | 1.00 % |
| 2011 | 217.5 | 0.42 % |
| 2010 | 216.6 | 8.97 % |
| 2009 | 198.8 | -9.86 % |
| 2008 | 220.5 | 6.22 % |
| 2007 | 207.6 | |

Source: <https://knoema.com/atlas/Malaysia/CO2-emissions>

Road transport plays a crucial role in facilitating daily economic activities in Malaysia and serves as the primary mode of transportation. Despite ranking as the third largest emitter of CO₂, following the industrial and construction sectors, road transport in Malaysia heavily relies on fossil fuels, resulting in significant CO₂ emissions (Ong et al., 2011). The combustion of gasoline and diesel fuels contributes significantly to greenhouse gas emissions, thereby contributing to the exacerbation of climate change (Mustapa et al., 2016).

To promote awareness of the environmental impact of car-related emissions, it is essential to understand the negative environmental consequences associated with excessive car usage. Recognizing the importance of reducing carbon emissions and prioritizing the adoption of cleaner transportation alternatives becomes imperative in this regard (Shahid et al., 2014).

Table 2

CO₂ emission shares in Malaysia by mode of transport

| TRANSPORT MODE | Road | Air | Sea | Others |
|----------------|-------|-------|------|--------|
| Percentage | 85.3% | 12.9% | 0.4% | 1.4% |

Source: (Briggs & Leong, 2016)

Table 2, exemplify that road transportation contributed 85.2% gross CO₂ pollution, followed by air 12.9 % and marine 0.4 %. Whereas in table 3, the result showed that

Table 3

CO₂ contributions by different types road vehicles

| TYPE OF VEHICLE | Car | Motorcycle | HDV | LDV | BUS |
|--------------------------|------------|------------|-----|-----|-----|
| CO ₂ Emission | 59% | 11% | 17% | 10% | 3% |
| Total | 70% | | | | |

Source: National Transport Policy 2019-2030. Ministry of Transport.

Based on the information provided in Table 3, it is evident that the collective CO₂ emissions from cars and motorcycles constituted a significant portion of CO₂ amounting to 70% of the total emissions. Specifically, private cars accounted for 59% of the CO₂ emissions, whereas motorcycles contributed 11% to the overall CO₂ output. The remaining 27% of emissions can be attributed to road freight and buses. Given the substantial impact of road mobility on CO₂ emissions, it becomes imperative for Malaysians to have access to accurate and dependable CO₂ emission data.

Awareness among drivers on CO₂ emission by car

Environmental awareness refers to people's knowledge, comprehension, and care about the environment and its effects (Pfertner et al., 2017). It addresses climate change, pollution, deforestation, biodiversity loss, and resource depletion (Taniguchi et al., 2002). Environmental awareness entails understanding the need for sustainable practices and taking steps to reduce environmental harm. Environmental awareness in Malaysia would include learning how automotive emissions contribute to greenhouse gas emissions, notably CO₂ and climate change (Kørnø et al., 2020). It involves acknowledging transportation's carbon emissions and the need for more sustainable transportation (Rahman et al., 2009).

Malaysian public awareness initiatives, educational programs, and government regulations that promote sustainable transportation and carbon footprint reduction may help raise knowledge of automotive CO₂ emissions as environmental knowledge helps people and communities make educated decisions and reduce CO₂ emissions from automobile use, leading to a more sustainable and ecologically friendly future (Masud et al., 2013).

Damaging Effects of CO₂ Emissions on Environment

CO₂ emissions harm the ecosystem in several ways, principally by causing climate change and its ramifications (Usman et al., 2021). According to Davis (2010), CO₂ levels in the atmosphere have increased as a result of human activity, particularly the combustion of fossil fuels that lead to the worsened greenhouse effect, which causes global warming, altered weather patterns, increasing sea levels, and severe weather occurrences including storms, droughts, and heatwaves.

Ocean acidification occurs when the seas absorb too much CO₂. Ocean acidification threatens the health and biodiversity of the marine environment because coral reefs, shellfish, and other species with calcium carbonate shells have trouble building and maintaining protective structures under acidic circumstances (Tresguerres et al., 2017).

The ecosystem has been disrupted significantly on a global scale due to changes in temperature and rainfall that impact some plant and animal species (Draper et al., 2019). Glaciers and ice caps melting has become severe, according to (Ganopolski, 2017). When temperatures rise due to CO₂ emissions, glaciers, and ice caps melt, leading to low-lying islands, coastal cities, and infrastructure all under risk from rising sea levels. Agriculture, drinking water, and ecosystems are all impacted by glacial meltwater (Maddah et al., 2016).

Many other approaches may be taken to reduce carbon dioxide emissions, such as switching to renewable energy, increasing energy efficiency, adopting sustainable land-use practices, and encouraging the development of carbon capture and storage technology (Mahmood, 2021).

Awareness and Understanding

According to Masud et al (2015), a study suggests that Malaysians lack awareness regarding climate change. At the same time, numerous studies have identified knowledge gaps and limited understanding of climate change at the national level (Ehsan et al., 2022).

A study conducted in 2007 by the World Wildlife Fund-Malaysia and its partners uncovered that just 45% of adults and students in Malaysia were aware of environmental issues (Salih et al., 2009). This finding aligns with Pew Global's statement in 2006, which indicates that emerging countries like Malaysia tend to have lower levels of environmental awareness compared to industrialized nations with higher awareness levels. The research conducted by Rahman H. A. (2018) further emphasizes the need for enhanced climate change education in Malaysia. It underscores the significance of adopting interdisciplinary approaches and considering human factors to effectively raise awareness about the causes of climate change.

To enable well-informed decision-making, encourage sustainable practices, and effectively address climate change, it is imperative for Malaysia to give priority to improving climate change awareness nationwide (Monroe et al., 2019). Collaborative efforts involving governments, non-governmental organizations (NGOs), and educational institutions can play a significant role in disseminating information about climate change and promoting sustainable behaviors, mitigation, and adaptation within communities (Karpudewan et al., 2015). By promoting awareness, Malaysian communities can enhance their ability to adapt to the challenges presented by climate change (Al-Amin et al., 2020).

Eco-Friendly Environment

By placing equal importance on ecosystem balance, biodiversity, and natural resource conservation, alongside efforts to reduce waste and conserve water, energy, and materials, individuals contribute to creating environmentally friendly environments that prioritize sustainability, and environmental protection is essential (Qambrani et al., 2017). In such eco-friendly settings, using renewable energy sources like solar, wind, and hydropower is crucial in minimizing greenhouse gas emissions and reducing resource consumption (Riti et al., 2016). Efficient waste management plays a significant role in maintaining ecosystems that rely on biodiversity by mitigating contamination, resource depletion, and excessive landfill use. This is achieved through practices such as waste reduction, reuse, and proper disposal. Sustainable land use and agriculture practices, including organic farming, regenerative techniques, and agroforestry, contribute to ecological balance, reduce reliance on pesticides, and improve soil health (Thakur et al., 2017).

Integrating urban trees, green infrastructure, and eco-friendly urban design further contributes to developing eco-friendly environments. These measures improve air quality, provide animal habitats, and help mitigate the urban heat island effect (Rayan et al., 2021). Achieving eco-friendly surroundings requires collaboration among individuals, groups, businesses, and governments, as ecological awareness fosters environmental consciousness and facilitates sustainable choices. Shove et al (2013) say that the goal of humans living in

harmony with nature is more likely to be reached if people work to protect the environment and use sustainable practices.

Perception and Awareness on Eco-friendly

Malaysians' perspectives on building a green society can vary, influenced by several factors. Educational initiatives, public awareness campaigns, and environmental programs play a significant role in shaping eco-consciousness among Malaysians, with the involvement of governments, NGOs, and schools fostering eco-friendly attitudes from an early age (Hanifah et al., 2015). Additionally, as highlighted by Daniel (2022), cultural practices and societal norms contribute to the level of eco-friendliness exhibited by individuals.

Traditional values can impact attitudes toward environmental conservation and sustainability, while disparities between urban and rural areas may affect environmental awareness (Ogiemwonyi et al., 2021). Urban dwellers tend to display higher levels of environmental consciousness, whereas rural communities may face different challenges due to limited eco-friendly resources and expertise (Hassan et al., 2013).

Environmental policies, incentives promoting eco-friendliness, and regulatory frameworks can also influence sustainable behaviors (Kaffashi et al., 2019). Media platforms, including news outlets, films, and social media, play a crucial role in raising environmental awareness, with positive media coverage and effective communication contributing to promoting sustainability consciousness (Junsheng et al., 2019). Environmental education, accountability, and sustainable behaviors in Malaysia are encouraged through initiatives involving schools, communities, environmental organizations, and public-private partnerships (Im et al., 2014).

Aspects that can influence drivers' awareness on environmentally friendly

Drivers can acquire knowledge about sustainable development and the environmental implications of transportation through various channels. Potential sources of information include formal education, public awareness initiatives, media coverage, and organizational information (Dauda et al., 2018).

Measures such as carpooling, congestion pricing, and electric car subsidies can potentially educate and incentivize drivers to adopt environmentally friendly practices (Isa et al., 2021). Furthermore, media coverage and communication campaigns are vital in raising awareness about sustainable transportation, environmental issues, and eco-friendly activities (Yusof, 2022).

The support of sustainable transportation by the local community influences drivers' inclination towards eco-friendly practices, driven by peer pressure and social norms (Saleem et al., 2023). Some drivers may independently choose sustainable mobility due to their interest in environmental concerns or desire sustainable living, resulting in resource conservation, reduced carbon emissions, and improved environmental conditions. Compelling educational materials, targeted campaigns, and the availability of sustainable transportation options can further assist drivers in understanding and embracing sustainable development (Hasbullah et al., 2022).

Governments, organizations, and communities have a role to play in promoting sustainable mobility, eco-friendly driving, and behavior change. Driver education and licensing should incorporate concepts related to sustainable development (María Ferrer-Estévez, 2021).

Conceptual framework

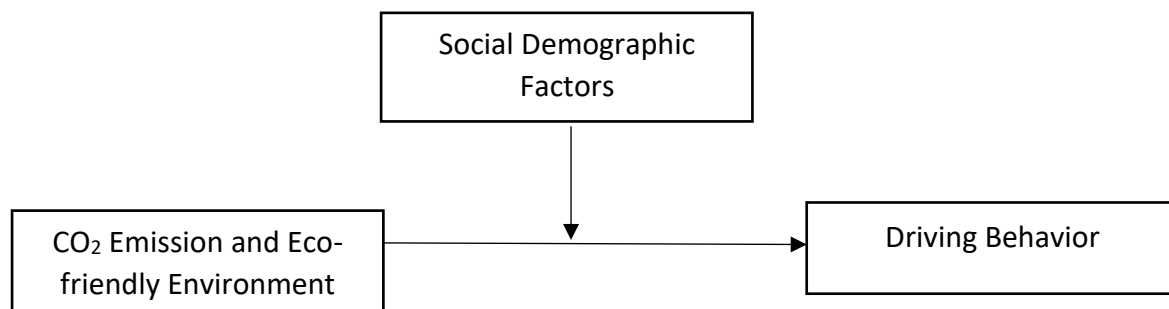


Figure 1: Conceptual Framework

Study Methodology

A survey instrument based on a questionnaire was created, and its measurement scales were initially assessed to verify the validity of the content. Subsequently, the revised iteration of the questionnaire was employed to evaluate the viability of the proposed framework. The participants for this study were chosen using a targeted purposive convenience sampling method.

The selection criteria focused on active drivers aged 18 and above residing in the Klang Valley region. It is estimated that this region is home to approximately 3 million individuals. The questionnaires were disseminated over four months, yielding a total of 425 successfully completed responses. In order to evaluate the suggested framework, the researchers utilized Structural Equation Modeling with Partial Least Squares (PLS-SEM).

This study's primary goals were to examine drivers' attitudes toward promoting sustainability and their inclination to adopt environmentally friendly driving practices. The study also aimed to evaluate how social-demographic factors influence the relationship between awareness of CO₂ emissions and adopting eco-friendly driving behaviors. These objectives were informed by previous research conducted by (Hair et al., 2012; Astrachan et al., 2014; Hair Jr et al., 2017; Hair, 2012).

The analysis in this study utilized SmartPLS 4.0 software, a commonly employed tool for conducting statistical analysis. To evaluate the significant influence of the variables, a bootstrapping technique was employed with 5000 replications. This approach aligns with the guidelines provided by (Hair et al., 2017; Henseler and Chin, 2010).

The normality of the data was assessed by examining the skewness and kurtosis statistics. The data exhibited a distribution that closely approximated a normal distribution, as evidenced by the Skewness and Kurtosis statistics falling within the acceptable range of ± 2.0 (Hair et al., 2012). Therefore, the parameter estimates obtained from the bootstrapping technique were considered valid and dependable for this study (Hair et al., 2012; Hair Jr et al., 2017).

Demographics

Table 1 provides an overview of the demographic statistics, which describe the characteristics of the sample. The table presents detailed findings related to the demographic respondent's profile data.

Table 1

Demographic Profile of Respondent

| Demographic Variables | Categories | Frequency | Percentage |
|-----------------------------------|--------------------|------------------|-------------------|
| Age | Under 18 | 1 | 2 |
| | 18-24 | 104 | 24.6 |
| | 25-34 | 82 | 19.4 |
| | 35-44 | 84 | 19.9 |
| | 45 and above | 151 | 35.8 |
| Gender | Women | 135 | 32 |
| | Men | 287 | 68 |
| Daily Traveling Activities | To college | 85 | 20.1 |
| | To work | 276 | 65.4 |
| | To do house chore | 61 | 14.5 |
| Daily travel distance | less than 50km | 311 | 73.7 |
| | 50 - 100 km | 83 | 19.7 |
| | 100-150 km | 16 | 3.8 |
| | 150 - 200km | 4 | 0.9 |
| | 150 - 200km | 8 | 1.9 |
| Employment Status | Employed full time | 290 | 68.7 |
| | Employed part-time | 47 | 11.2 |
| | Own business | 39 | 9.2 |
| | Retired | 46 | 10.9 |

Measurement Model Estimation

The results of the assessment for convergent validity of the measurement model are presented in Table 2. All indicators used to assess the constructs in this study met the minimum criterion of a loading value exceeding .70, as Hair et al (2012) advised. According to Hair Jr et al (2017), the Average Variance Explained (AVE) for each construct surpassed the threshold of .50, suggesting satisfactory convergent validity.

Furthermore, it is worth noting that the reliability tests conducted on the constructs, namely Composite Reliability and Cronbach's Alpha, yielded values exceeding .70. This indicates a high level of internal consistency, as established by (Hair Jr et al., 2017). The present findings provide empirical support for the soundness of the measurement model with respect to its adherence to the concept of one-dimensionality.

Table 2
Convergent Validity for Measurement Model

| Indicator | Loading | AVE | γ | α |
|---|---------|-------|----------|----------|
| CO₂ Emission and Eco-friendly Environment | | | | |
| Have you heard of the term "eco-friendly" before? | 0.934* | 0.867 | 0.953 | 0.933 |
| Have you heard that it is important to protect the environment? | 0.917* | | | |
| Have you known what it means to be eco-friendly? | 0.943* | | | |
| Have you ever taken any actions to be more eco-friendly? | 0.932* | | | |
| Driving Behavior | | | | |
| Have you ever engaged in aggressive driving behaviors, such as overtaking other vehicles or tailgating? | 0.829* | 0.764 | 0.869 | 0.699 |
| Have you ever typically accelerated while exiting a toll booth? | 0.909* | | | |
| Social Demographic Factor | | | | |
| What is your travelling activity? | 0.882 | 0.924 | 0.903 | 0.799 |
| What is your age? | 0.933 | | | |

Note: AVE = Average Variance Explained; γ = Composite Reliability; α = Cronbach's Alpha; *p <.05.

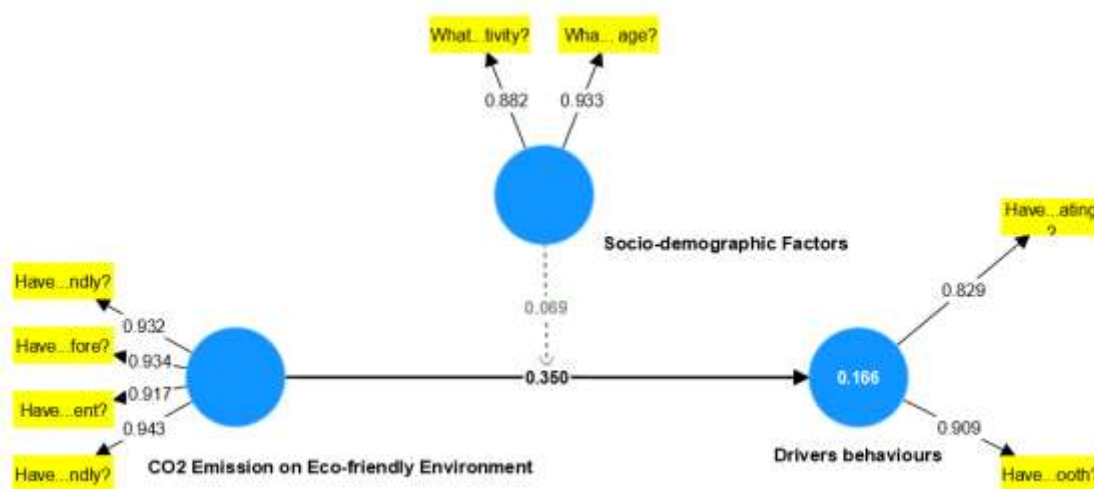


Figure 1: Factor Assessment

The discriminant validity assessment was conducted using the Heterotrait Monotrait (HTMT) ratio, as presented in Table 3. The criterion in question is regarded as the most rigorous among the different criteria used to assess discriminant validity. These criteria include the cross-loading criterion and the Fornell and Larcker (1981) criterion. The findings suggest that the study successfully established discriminant validity, as evidenced by all HTMT values falling below the threshold of 0.85.

Table 3

Heterotrait-monotrait ratio (HTMT)

| | CO2 | DB | Socio-demographic Factors |
|---------------------------------|-------|-------|---------------------------|
| CO2 | | | |
| DB | 0.382 | | |
| Socio-demographic Factors | 0.150 | 0.270 | |
| Socio-demographic Factors x CO2 | 0.117 | 0.079 | 0.151 |

Structural Model Estimation

This study investigated the impact of social demographic factors, precisely age and driving activities, on the correlation between CO2 emissions and environmentally friendly driving behavior (DB). The findings in Table 4 indicate that the R-square value for driving behavior (DB) was determined to be 0.096 without considering the potential moderating effect.

The finding suggests that 9.6% of the observed variations in driving behavior can be attributed to the influence of CO2 emissions and social demographic factors. Nevertheless, upon incorporating the interaction term into the analysis, as depicted in Table 5, the coefficient of determination (R-square) exhibited an augmentation of 16.6%.

This implies that incorporating the interaction term contributed an additional 7% of the explained variance in driving behavior. In more accessible language, the findings indicate that certain social demographic factors can influence the connection between CO2 emissions and promoting environmentally friendly practices, specifically concerning individuals' driving habits.

Table 4

Without moderating effect

| Relationship | Beta | SE | T-value | 95% confidence interval | | P-Value | R-square | f-square |
|--------------|-------|-------|---------|-------------------------|-------|---------|----------|----------|
| | | | | Upper | lower | | | |
| CO2 --> DB | 0.312 | 0.047 | 6.601 | 0.218 | 0.399 | 0 | 0.096 | 0.106 |

Note: SE=Standard Error, f-square= effect size

Table 5

Inclusion with moderating effect

| Relationship | Beta | SE | T-value | 95% confidence interval | | P-Value | f-square | R-square |
|--|-------|-------|---------|-------------------------|-------|---------|----------|----------|
| | | | | Upper | lower | | | |
| CO ₂ Emission on Eco-friendly Environment -> Driver's behaviors | 0.352 | 0.044 | 7.886 | 0.263 | 0.435 | 0.000 | 0.133 | |
| Socio-demographic Factors -> Driver's behaviors | 0.254 | 0.049 | 5.043 | 0.156 | 0.350 | 0.000 | 0.072 | 0.166 |
| Socio-demographic Factors x CO ₂ Emission on Eco-friendly Environment -> Driver's behaviors | 0.066 | 0.054 | 1.282 | -0.039 | 0.172 | 0.200 | 0.006 | |

Note: SE=Standard Error, f-square= effect size, significance at p-value <0.05

The researchers examined the importance of the moderating effect. They found that the results presented in Table 5 demonstrate a positive but statistically insignificant influence of social demographic factors (such as age and driving activities) on the association between

CO2 emissions and the eco-friendly environment (CO2) and driver behaviors (DB) ($\beta = 0.066$, t -value = 1.282, p -value > 0.05). The result implies that the impact of social demographic factors on the correlation between CO2 emissions, environmentally friendly practices, and driving behavior was not statistically significant.

The findings also indicate a significant correlation between CO2 emissions and promoting an environmentally friendly atmosphere through driver behaviors, with an effect size of 0.133. Additionally, there is a modest correlation between social demographic factors and driver behaviors, with an effect size of 0.072. Furthermore, the interaction between social demographic factors and CO2 emissions to promote an environmentally friendly atmosphere through driver behaviors is minimal, with an effect size of 0.006. In more concise language, the results indicate that social demographic variables did not substantially influence the association between CO2 emissions, environmentally friendly practices, and driving behavior within the scope of this investigation.

The analysis of effect sizes yielded significant findings regarding the interrelationships among the variables under scrutiny. The observed effect size of 0.133 of the correlation among CO2 emissions, promoting an eco-friendly environment, and driving behaviors signify a moderate effect, implying a discernible connection between these variables. The effect size of 0.072, which pertains to the association between social demographic factors (e.g., age and driving activities) and driver behaviors, indicates a moderate effect.

The result suggests that social demographic factors moderately influence driver behaviors. Nevertheless, it is essential to acknowledge that the analysis also indicated a lack of significant moderating influence from social demographic factors on the correlation between CO2 emissions, eco-friendly environment, and driver behaviors. The observed effect size of 0.006 of the interaction term indicates a minimal and insignificant influence, implying that social demographic factors do not significantly impact the association between CO2 emissions, eco-friendly environment, and driver behaviors. Figure 2 depicts the model illustrating the moderating effect.

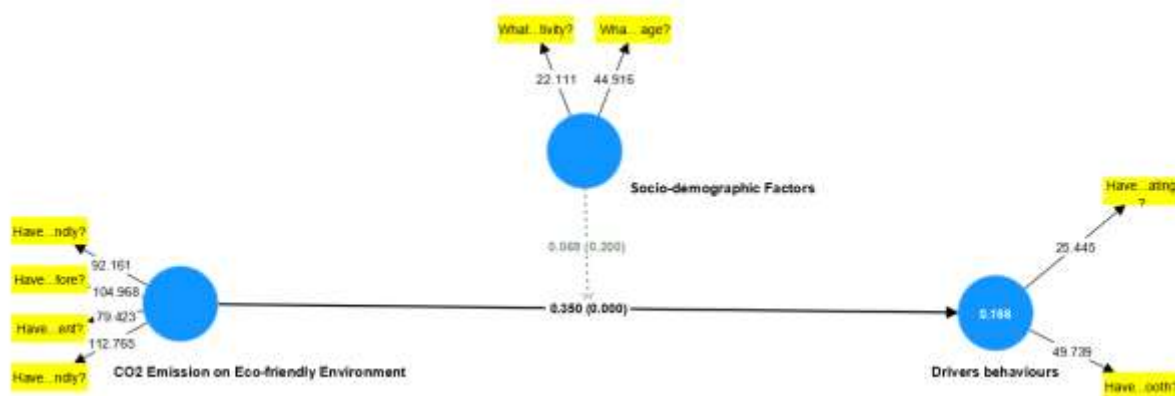


Figure 2: Moderating effect model

In this study, a slope analysis was performed in order to enhance comprehension of the moderating effect. The findings indicated that an increase of one standard deviation in social demographic factors was associated with a more pronounced and positive slope in the relationship between CO2 emissions and the eco-friendly environment. Conversely, the relationship exhibited a less pronounced and positively inclined gradient when social demographic factors were one standard deviation below the mean.

This finding suggests that the influence of social demographic factors on CO2 emissions in promoting an eco-friendly environment is contingent upon drivers' behavior. The results are visually represented in Figure 4, which displays the diverse slopes of the association. The analysis revealed that the influence of social demographic factors on CO2 emissions and promoting an eco-friendly environment is contingent upon drivers' behavior.

The correlation between social demographic factors and drivers' behavior is strengthened and becomes more positive as drivers demonstrate increased positive behavior. However, when drivers exhibit less positive behavior, the correlation between their behavior and the relationship weakens and becomes less favorable. The finding implies that drivers' behavior substantially influences the relationship between social demographic factors and their impact on CO2 emissions and the promotion of an eco-friendly environment.

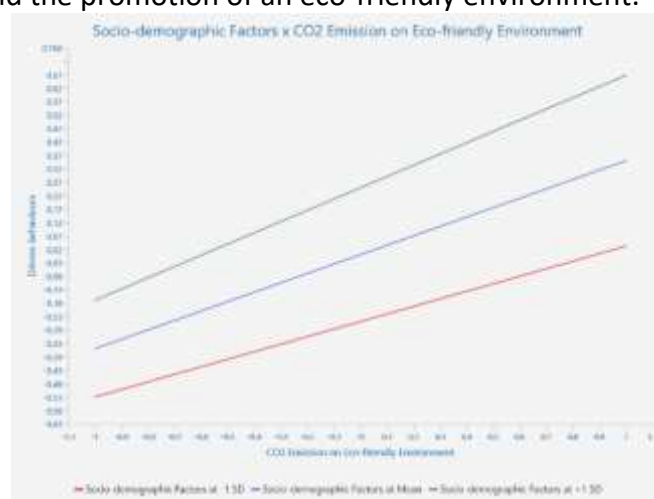


Figure 4: Slope Analysis

Discussion

The outcomes of this study provide significant contributions to understanding the intricate connections among carbon dioxide emissions, environmental sustainability, driving habits, and socio-demographic variables. The study's measurement model was deemed valid, suggesting that the chosen indicators successfully assessed the constructs under investigation. This practice guarantees that the data collected is an accurate and precise representation of the variables being studied. The analysis unveiled a significant correlation between carbon dioxide emissions, environmentally sustainable surroundings, and driving conduct.

The study's findings revealed a moderate effect size, suggesting a discernible relationship between the factors. This discovery underscores the significance of considering CO2 emissions and their ecological consequences in examining driving patterns. The findings indicate that individuals with a higher awareness of the environmental repercussions associated with their driving habits are more inclined to engage in environmentally conscious behavior. Nevertheless, the research revealed that social demographic variables, such as age and driving habits, did not significantly impact the association between CO2 emissions, environmental sustainability, and driving conduct.

Although these factors have a moderate effect on driving behavior, their influence on the impact of CO2 emissions on eco-friendly practices is not significant. The result suggests that additional factors, besides social demographic characteristics, may significantly influence individuals' behavior concerning CO2 emissions and environmental sustainability.

Additionally, the research conducted a slope analysis to investigate the moderating impact of drivers' behavior on the correlation between social demographic factors and CO2 emissions concerning the promotion of an environmentally friendly setting.

The study's findings suggest that drivers' behavior influences the relationship. The influence of social demographic factors exhibited a heightened and positive effect during a period characterized by more favorable driver behavior. On the contrary, the influence of drivers' behavior was diminished when it exhibited less favorable characteristics.

Theoretical Implications

The study holds significant theoretical implications for environmental psychology and sustainability research disciplines. The findings of this study enhance the current theoretical framework by emphasizing the significance of individual awareness, attitudes, and behavior concerning carbon dioxide emissions and the preservation of the natural environment. The study highlights the significance of comprehending individuals' level of awareness regarding the environmental ramifications associated with carbon dioxide emissions.

This finding provides empirical support for the cognitive behavioral theory, which posits that acquiring knowledge and cultivating awareness play pivotal roles in promoting pro-environmental behavior. Furthermore, this study emphasizes the importance of considering drivers' attitudes toward promoting sustainability and their inclination to engage in environmentally conscious driving behaviors.

Furthermore, the research also emphasizes the moderating influence of driver behavior on the association between social demographic factors and carbon dioxide emissions to ecological well-being. This study contributes to the knowledge of how individual traits and environmental outcomes interact, emphasizing the significance of incorporating behavioral factors within the sustainability framework.

Conclusion

This study elucidates the level of consciousness regarding CO2 emissions attributed to automobiles and the promotion of an environmentally sustainable ecosystem within the automotive sector of Malaysia. The study primarily focuses on drivers' viewpoints and aims to investigate the level of awareness among drivers regarding the environmental consequences associated with CO2 emissions. Additionally, it sought to analyze drivers' attitudes towards promoting sustainability and their inclination towards adopting environmentally friendly driving practices.

The findings of this study align with prior research conducted in this field. The significance of comprehending individuals' awareness of carbon emissions and their inclination to engage in pro-environmental behavior has been underscored in the research conducted by (Armenio et al., 2022). Similarly, the research conducted by Testa et al (2021) has emphasized the significance of investigating drivers' attitudes toward the environment and their contribution to the advancement of sustainability.

The measurement model employed in this study demonstrated good validity and reliability levels, enhancing confidence in the obtained results. Consistent with prior studies, the findings suggest a notable association between CO2 emissions, the ecological landscape, and driving behavior (Hanifah et al., 2015; Daniel, 2022). The study highlights the necessity of advocating for eco-friendly driving habits and increasing public consciousness regarding the ecological consequences associated with carbon dioxide emissions.

Nevertheless, the study also revealed that social demographic variables, such as age and driving activities, did not significantly impact the association between CO₂ emissions, the ecological environment, and driving behavior. These findings align with the research conducted by Wang et al (2021) and indicate that factors beyond social demographics may significantly impact individuals' attitudes and actions regarding carbon emissions and environmental sustainability.

Furthermore, the analysis elucidated that driver behavior influences the correlation between social demographic factors and CO₂ emissions within the context of the ecological environment. This discovery supports the assertions made by Liew P. et al. (2020), who emphasized the significant role of individual behavior in mediating the influence of social factors on environmental outcomes. The implications of these findings hold significant importance for policymakers and industry stakeholders within the automotive sector in Malaysia.

This study highlights the necessity of providing drivers with education regarding the environmental consequences associated with CO₂ emissions, as well as advocating for adopting more environmentally sustainable driving behaviors. Drawing upon the findings of a prior investigation conducted by Wang T et al. in 2018, it is imperative to devise focused approaches that transcend social demographics to foster sustainable behavior successfully. The findings of this research contribute to the current pool of knowledge by offering valuable insights into the interconnections among CO₂ emissions, environmental sustainability, driving patterns, and social demographics within the automotive sector of Malaysia.

The motivation behind this compelling research is the urgent need to address the pressing environmental challenges posed by CO₂ emissions in the Malaysian automotive industry. As global concerns about climate change increase, understanding drivers' awareness and perceptions of their role in promoting a green environment is paramount (Hoffmann et al., 2022). The unique contribution of this study lies in its comprehensive examination, which addresses the complex relationships between carbon emissions, environmental sustainability, driving behavior, and socio-demographic factors. By shedding light on drivers' knowledge and feelings about CO₂ emissions and the planet's future, the research aims to unlock the key to promoting environmentally responsible driving habits. The results show a discernible link between awareness of environmental impacts and environmentally responsible behavior and provide crucial insights for policymakers, industry stakeholders, and environmental organizations. Furthermore, examining the moderating effect of driver behavior on the correlation between social demographics and CO₂ emissions extends the study's findings, making it a compelling piece of research that has the potential to catalyze targeted interventions and initiatives to promote sustainable practices in the Malaysian automotive industry.

In summary, this research makes a valuable contribution to the current corpus of knowledge by offering valuable insights into the interconnections among carbon dioxide emissions, environmentally sustainable practices, driving habits, and sociodemographic variables within the automotive sector of Malaysia. Future research should investigate supplementary variables that could impact individuals' pro-environmental behaviors while formulating efficacious approaches to foster sustainable conduct on carbon emissions and the environment. Therefore, this study is consistent with prior research in the field.

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