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Research Paper

Non-Driving Related Activities Inside an Automated Vehicle Among Malaysia Passengers

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Abstract

The advancement of automotive technology has led to the development of automated vehicles. The trend of passengers performing non-driving related activities during travel was expected to be continued in the future automated vehicle. It is essential to discover the type of activities that the users prefer to improve the interior design of an automated vehicle. Past studies show that every country has different preferred non-driving related activities. The main objective of this study is to collect data on preferred non-driving related activities, specifically by Malaysians, using online questionnaires. 293 respondents answered the questionnaires in six (6) months. As a result, the top three (3) non-driving related activities in Malaysia are listening to music, calling or texting, and interacting with others. In addition, the most preferred seating position as a passenger, the most suitable travel duration to perform non-driving related activities uninterrupted, and the preferred seating configuration of the automated vehicle were also discovered. The outcome of this study will add knowledge for designing better future automated vehicles suitable for Malaysian users.

Keywords: NDRA; Automated vehicle; Vehicle passenger

1. Introduction

An automated vehicle is one of the future technologies being experimented with by various developers and researchers worldwide. An automated vehicle is a self-driving vehicle that does not requires interactions between human and vehicle to control the manoeuvre and move toward its destination. Several levels of automation have been described related to a vehicle. Most countries use the Society of Automotive Engineers standards, which consists of Level 0 to Level 5 [1]. An automated vehicle from Level 3 to Level 5 allows the driver to engage in non-driving related activities (NDRA) and ignore the driving tasks. According to the Department of Transport of the United Kingdom [2], a driver in England spends 235 hours, equivalent to 6 working weeks driving on roads. Utilising the driving period into something useful will benefit those needing it. Based on a survey from six (6) European countries involving 300 drivers with 90,000 driving hours, the drivers spend 10% while the truckers spend 20% of their driving time performing NDRA [3]. Dogan *et al.* [4] observed in an experiment that the drivers tended to perform NDRA even when driving a non-automated vehicle. The data shows that passengers and drivers were inclined to engage in NDRA during travelling. In addition, passengers of the future automated vehicle with a defensive driving style will be more comfortable and trust

the machine for their safety [5]. Hence, this indicates that NDRA will continue to be popular regardless of whom drives them around, a human or a machine. However, the problem with doing NDRA during travel is that it can increase the risk of motion sickness [6].

Motion sickness is a problem that leads to unwell feelings when travelling on various modes of transportation [7]. This problem will eventually lead to various impacts on human health, from minor symptoms such as sweating to significant symptoms such as vomiting. Motion sickness will interrupt the quality of NDRA, which is a drawback of travelling in an automated vehicle [8], [9]. Hence, the researchers need to investigate the type of NDRA preferred by the users before a solution for mitigating motion sickness can be discovered. This investigation ensured that the targeted users could fully utilise the solution produced.

Previous studies have investigated the NDRA preferred by non-automated vehicle passengers from various countries. The investigations were done mainly by collecting data via an online survey [10], [11], through in-situ observation and interviews [12], [13], and by conducting experiments [14]. Researchers already include several countries in the NDRA studies, such as the United Kingdom, the United States of America, China, India, Japan, Canada, Bangladesh, Australia, and Germany. Furthermore, the result of the study by Kyriakidis *et al*. [15] was gained through respondents from 109 countries (n = 5000), but the detail of which country was not known. From this observation, there was no data on preferred NDRA, specifically from Malaysian passengers, and this may create a problem if the future solution to motion sickness is not suitable for Malaysian passengers.

Based on past studies, the researchers used different approaches to collect the data, such as differentiating the NDRA based on travel type [11], time taken to complete the activities undisturbed, and different non-driving related activities depending on privacy level [16]. All factors eventually affect the results, where detailed questions might give more accurate feedback from respondents as they can give feedback based on a specific situation. In summary, regardless of the survey question and targeted country, the most preferred NDRAs were watching the road or scenery, listening to music, talking with other passengers, texting, calling, eating, drinking, reading, working, and studying. The data from previous studies were used in the current study as a benchmark to compare the results from various nationalities.

The purpose of this study was to fill in the missing data from the NDRA survey from Malaysia by having a detailed set of questionnaires adapted from past studies. The result will benefit the researchers from Malaysia to create a solution for motion sickness suitable for Malaysian passengers.

2. Literature Review

Several researchers have already collected and studied the preferred NDRA by future automated vehicle passengers from the background of various countries. The data from that research were taken, and the average percentage of each activity was calculated. For the countries that have been studied by two (2) or more researchers, the data were combined according to similar activities (e.g., "watching the road" and "looking at surroundings") and considering that the respondent was a different individual for every study.

From the collected data, the activities preferred were slightly different for each country. It was found that there were no significant differences as one of the top activities, watching the road, is present in all studied countries except for Canada. In addition, texting or calling and watching movies are commonly preferred activities in most countries. However, the data collected suggests that there will always be differences between countries, even though it is minor. The summary of the top three (3) preferred NDRAs from past researchers is summarised in **Table 1**.

3. Methods

The questionnaires in this study were adapted from a combination of past studies and were distributed online via Google Forms using dual language (English and Malay). It was divided into six (6) parts and summarised in **Table 2**.

In Part 1, demographic information such as age, marital status, working status, and highest education level was asked. Besides, there were several background questions related to drivers' and passengers' experiences.

Table 1. Top three (3) NDRA in various countries.

Country	Non-driving Related Activities (Percentage)	Researcher(s)
Australia	1. Watching the road (67.23%) 2. Interacting with others (62.04%) 3. Eating or drinking (52.95)	[10], [17]
German	1. Interacting with others (75.97%) 2. Listening to music (75.79%) 3. Watching the road (69.08%)	[12], [14], [16]
Bangladesh	1. Texting or calling (70.90%) 2. Watching the road (41.05%) 3. Listening to music (39.55%)	[11]
United States of America	1. Watching the road (51.86%) 2. Interacting with others (40.74%) 3. Eating or drinking (40.40%)	[17], [18]
United Kingdom	1. Watching the road (44.0%) 2. Texting or calling (23.0%) 3. Watching movies (7.6%)	[17]
Japan	1. Watching the road (33.2%) 2. Texting or calling (33.0%) 3. Watching movies (12.6%)	
China	1. Watching the road (36.10%) 2. Texting or calling (20.80%) 3. Watching movies (11.30%)	
India	1. Watching the road (30.7%) 2. Texting or calling (16.3%) 3. Watching movies (15.0%)	

Table 2. Sections of the questionnaire

Part	Question Title
1	Demography of respondents
2	Preferred Seat as A Passenger
3	Preferred NDRA as A Passenger in a Non-Automated Vehicle
4	Preferred Travel Duration to Perform NDRA Uninterrupted
5	Preferred NDRA as A Passenger in an Automated Vehicle
6	Extra Questions: a. Have you ever heard of automated vehicles before participating in this study? b. Since Automated Vehicle travels from one location to another by themselves, do you think you will need extra information such as turning direction, obstacle ahead, traffic condition, etc., apart from the destination? c. Which layout of the seating position inside an Automated Vehicle do you prefer?

For Part 2, a question regarding the most preferred seat as a passenger was asked, as its result will affect the seating position for future studies involving automated vehicles. **Figure 1** shows a seating layout of two (2) types of vehicles (5-seater and 7-seater) with seat labels as a guide for the respondents.

In Part 3, the NDRA preferred during travelling as a passenger in a non-automated vehicle was asked. The situation in this question was set in the current technology of the non-automated vehicle. The given choices were based on the most preferred NDRA from past studies (refer to Section 2.0), with the option to add other preferred activities that were not stated. The NDRA was divided into three (3) types of travel purposes: the workplace, holiday, and daily affairs. The activities were divided into six (6) categories, which were the inbound and outbound travel for the three (3) types of travel purposes stated earlier [11].

Next, Part 4 includes the preferred travel duration needed to complete the activities uninterrupted to assess any time-influence activities [16]. In this part, respondents were asked to state the individual preferred travel

Figure 1. Seating layout with labels.

duration to perform the listed NDRA. This is to assess the influence level of time towards the execution of those activities. Time variability plays a vital role in choosing activities to be done, as found in the study by Hecht *et al.* [16]. The travel duration was divided into five (5) periods, which were 0 to 20 minutes, 21 to 40 minutes, 41 to 60 minutes, 61 to 80 minutes, and above 81 minutes. The following part starts to include the automated vehicles in question.

As an introduction, Part 5 started with a simple explanation about the automated vehicle as it is not a typical vehicle technology on the road. It helps the respondents to have a better understanding of the concept of the automated vehicle. After that, the questions regarding preferred NDRA were asked again, but the setting was changed from the non-automated vehicle to the automated vehicle.

In Part 6, three (3) additional questions were asked for additional data in this study. The knowledge about automated vehicles among respondents was asked to compare with the respondents from other countries [11], [17]. Next, a question was asked about the need for extra information such as turning direction, obstacles ahead, or traffic conditions apart from the destination. The preferred layout of the seating position of an automated vehicle was asked, as the results from previous studies show a wide range of diversity [19]–[22]. The studies provide more complex situations such as different travel purposes (e.g., workplace or school, holiday), travel with different passenger categories (e.g., strangers, children, elderly) and various other variables. However, in this study, only a straightforward question involving the seating layout was asked. The seating layout in this section was adapted from [22] and can be seen in **Figure 2**.

4. Results and Discussion

4.1. Respondent

In this study, 293 participants (male = 170, female = 123) took part by answering the online questionnaires over six (6) months in 2022. The mean age of the participants was 27.68 years (SD = 6.92), ranging from 17 to 66 years old. Only 27 or 9% of the participants do not possess a driving license. For the rest of the participants, the mean years of having a driving license were 7.82 years (SD = 6.55). The participants' average travel distance per year as a driver and a passenger was 17,490 km and 16,820 km, respectively. Other demographic details are shown in **Figure 3**.

4.2. Preferred Seat as a Passenger

In this study, a question regarding the most preferred passenger seat was asked in the early section of the questionnaire. The layout of the seating position can be seen in **Figure 1** (see Section 3.0) and **Figure 4**, respectively.

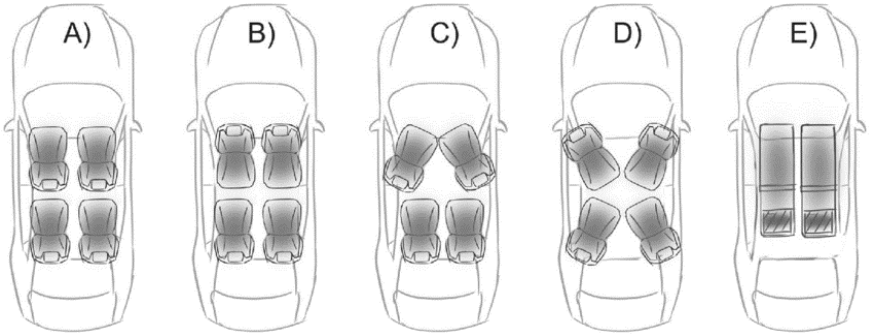


Figure 2. Different seating layout configurations for the automated vehicle [22]

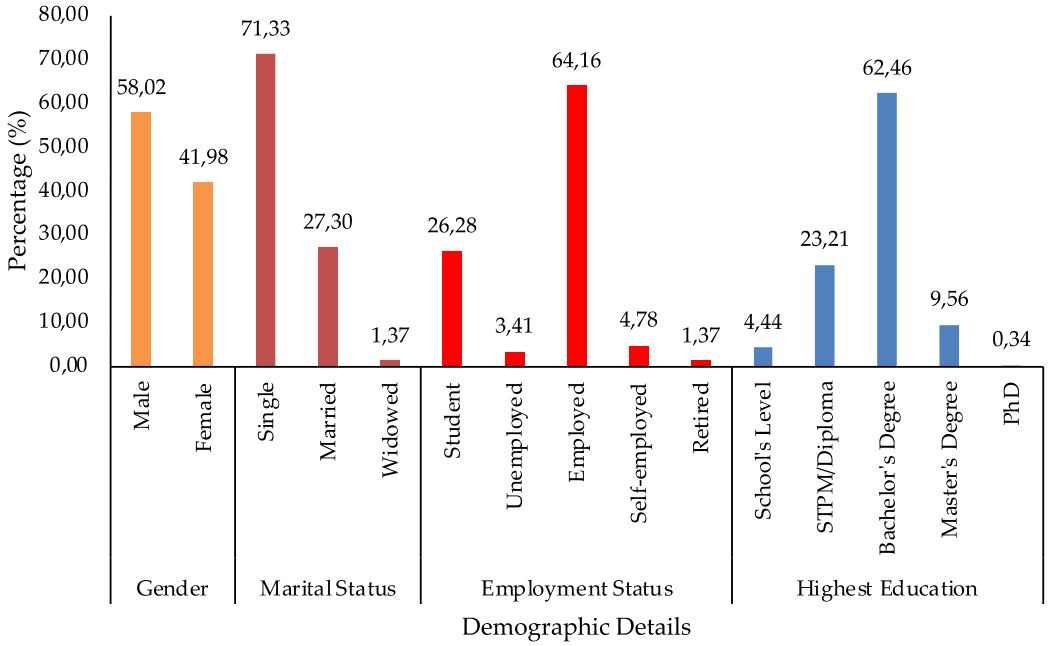


Figure 3. Demographic details of participants

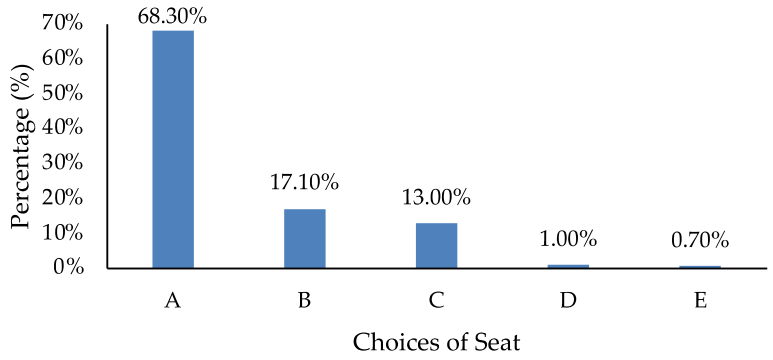
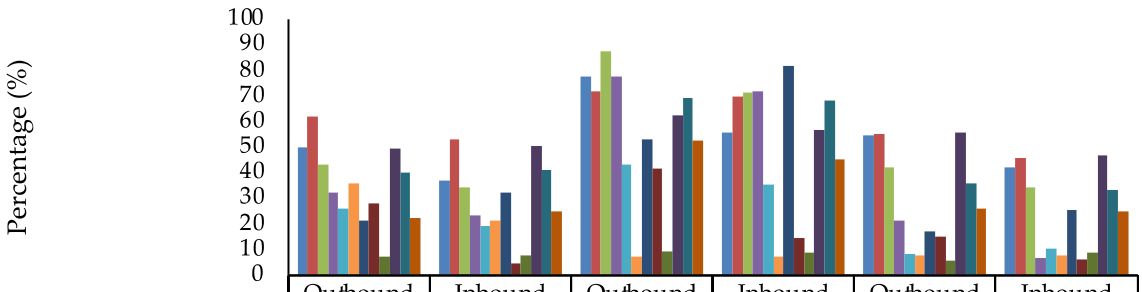


Figure 4. The result of the preferred seat as a passenger

Figure 4 shows a significant difference between all the seating choices, where Seat A is the most preferred at 68.30%. Seats B and C received similar results at 17.10% and 13.00%, respectively. Lastly, Seats D and E are the least preferred seats in a passenger vehicle, as they both received 1.00% and 0.70% each. This result shows that most respondents prefer Seat A as the primary choice when they become a passenger in a car. With this information, future studies involving a passenger in a driven car should use Seat A as the first choice in any experimental setup, followed by Seat B, C, D, and E.

4.3. Preferred Non-Driving Related Activities (NDRA) as a Passenger in Non-Automated Vehicles

Figure 5 shows the preferred NDRA in non-automated vehicles. It is found that, on average, travel for a holiday is the most preferred travel purpose to perform NDRA compared to travel for work and daily affairs, especially for sleeping or resting (52.90% for outbound and 81.91% for inbound) and watching the road or surrounding (87.71% for outbound and 71.33% for inbound). Regarding activities, listening to music is the most preferred NDRA (59.67% on average), while exercising is the least preferred NDRA (7.79% on average). Travels involving the workplace show a significant increase in working or studying (35.84% for outbound and 21.50% for inbound) compared to the same activity for holiday and daily travel. This situation was driven by most people leaving their working affairs behind during non-work hours. In addition, interacting with others, calling or texting, and browsing social media are among the most preferred non-driving related activities, averaging 52.96%, 53.58%, and



NDRA	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound
	Workplace		Holiday		Daily Affairs	
Interacting with others	50,17	36,86	77,82	55,63	54,95	42,32
Music	62,12	53,24	71,67	69,62	55,29	46,08
Watching road	43,00	34,13	87,71	71,33	42,32	34,47
Eating/drinking	32,42	23,55	77,82	72,01	21,50	6,83
Reading	25,94	19,11	43,34	35,49	8,19	10,58
Working/studying	35,84	21,50	7,17	7,17	7,85	7,51
Sleeping/resting	21,16	32,42	52,90	81,91	17,06	25,26
Grooming	28,33	4,78	41,64	14,68	15,02	6,14
Exercising	7,17	7,85	9,22	8,53	5,46	8,53
Calling/texting	49,49	50,51	62,46	56,66	55,63	46,76
Social Media	39,93	41,30	69,28	68,26	35,84	33,45
Web Browsing	22,53	24,91	52,56	45,39	25,94	24,91

Figure 5. Percentage of preferred non-driving related activities (NDRA) in non-automated vehicles

48.01%, respectively. Other activities that respondents added were playing games, singing, and helping the driver with navigation.

There were only slight differences between the passenger of the non-automated vehicle from Malaysia and other countries. The top three (3) of the most preferred NDRA among Malaysians in the current technology of non-automated vehicles are listening to music, calling or texting, and interacting with others. From past studies, those activities were already presented in the top three (3) for various countries, except for calling or texting, that only can be found in India [17]. However, this questionnaire only includes the preferred activities in the non-automated vehicle. To ensure accuracy and make it comparable with other studies, a question involving preferred NDRA inside automated vehicles was asked in the later part of this questionnaire.

4.4. Preferred Travel Duration to Perform NDRA Uninterrupted

The activities with the most preferred travel duration can be seen in **Figure 6**. Most activities were preferred to be performed in the first 20 minutes of the travel duration. Those activities were interacting with others (29.35%), eating or drinking (34.13%), reading (47.44%), working or studying (75.43%), grooming (66.21%), exercising (81.23%), calling or texting (31.74%), using social media (32.08%), and browsing the internet (48.81%). Next, sleeping or resting is the majority at 21 to 40 minutes (35.49%). For the travel duration of 41 to 60 minutes, listening to music and watching the road received the highest percentage at 30.38% and 33.11%, respectively.

The data collected shows that 42% of respondents only need less than 20 minutes to perform activities on average. The data suggest that Malaysians can do various activities in a short travel duration. Moreover, using a personal device (e.g., laptop, smartphone) to perform NDRA, such as texting or calling, working or studying, browsing the internet, and using social media, does not require a long and complicated setup. Hence, the device's simplicity encourages users to perform those activities even in a short period. In addition, most respondents required 21 to 40 minutes to have uninterrupted sleep or rest. This data shows a similar result to the study done

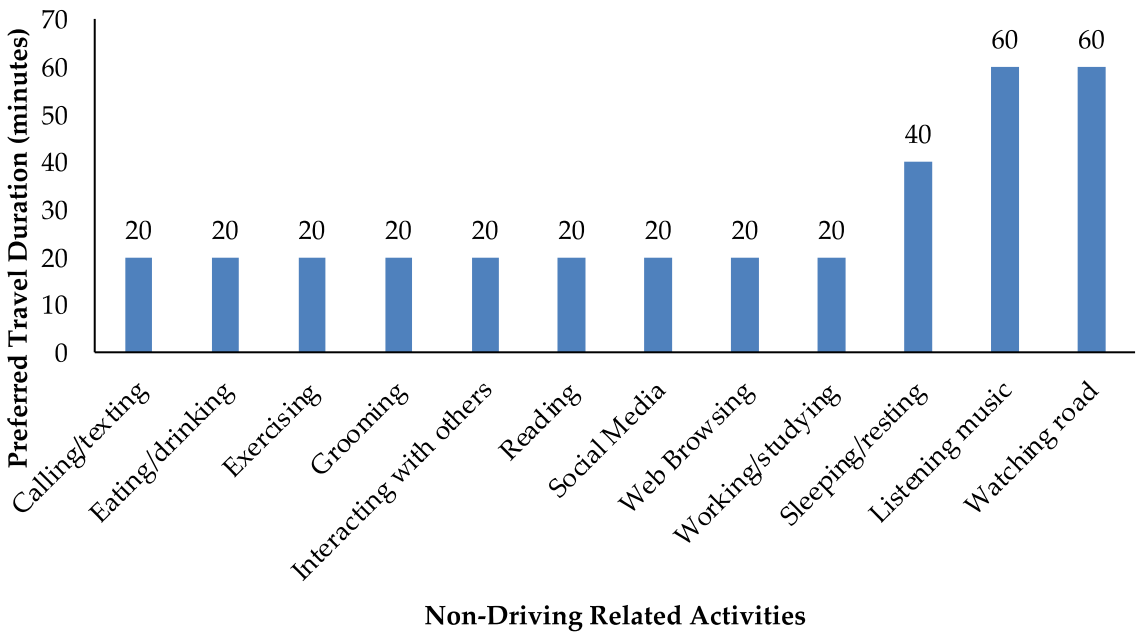
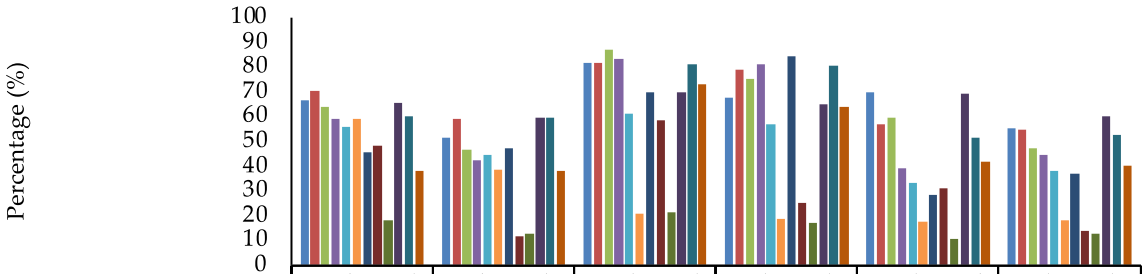


Figure 6. Preferred travel duration to perform NDRA

by Hecht *et al.* [16], as they found that sleeping was preferred in a later phase of a journey. Next, the longest travel duration for listening to music and watching the road is 41 to 60 minutes. The data contradicted the results Hecht *et al.* [16] obtained, which show that passengers only needed 20 minutes to watch the surroundings. The results from this study suggest that most passengers in Malaysia stop doing any non-driving related activities that require the usage of an extra device or tools after the first 20 minutes. After 20 minutes, they tend to perform passive activities that are more relaxing and do not require a high level of focus. This may be due to motion sickness due to removing situation awareness from the passengers by having NDRA [23]. This situation also suggests a relation between the journey duration and the complexity of a particular NDRA, as shorter travel duration promotes active activities. In comparison, longer travel duration promotes passive activities.

4.5. Preferred Non-Driving Related Activities as A Passenger in Automated Vehicles

In this section, the list of activities in Part 4.3 was asked again with a different setting, which is in an automated vehicle. The result shows a percentage increase in all activities regardless of the type of travel movement. Most of the activities were still preferred to be done during the travel for vacation. One of the activities is reading during travel to the workplace (55.97% for outbound and 44.71% for inbound) and for daily affairs (33.11% for outbound and 38.23% for inbound) were less preferred compared to travel for a holiday (61.09% for outbound and 57.00% for inbound). However, working or studying during travel to the workplace shows a higher percentage (59.04% for outbound and 38.57% for inbound) compared to travel for a holiday (20.82% for outbound and 18.77% for inbound) and daily affairs (17.75% for outbound and 18.09% for inbound). This situation shows that most respondents left behind their work or studies when it was not critical. Another significant trend is that grooming activities were higher during outbound movement and lowered during inbound movement for all travel purposes. For travel to the workplace, the outbound journey for grooming was 48.12% compared to the inbound journey of 11.60%. The situation was the same for holiday and daily affairs purposes. This indicates that passengers prefer to groom before they arrive at their destination. In addition, the respondents added that playing games, singing, and watching movies are the other option for NDRA. Regardless of the situation, listening to music was still a favourite among Malaysian, as it was preferred by 66.95%, followed by interacting with others (65.53%) and calling or texting (64.85%). All results from this section can be seen in **Figure 7**.



NDRA	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound
	Workplace		Holiday		Daily Affairs	
Interacting with others	66,89	51,54	81,57	67,92	69,97	55,29
Music	70,31	59,04	81,91	78,84	57,00	54,61
Watching road	63,82	46,76	87,03	75,43	59,39	47,44
Eating/drinking	59,04	42,32	83,62	81,23	38,91	44,37
Reading	55,97	44,71	61,09	57,00	33,11	38,23
Working/studying	59,04	38,57	20,82	18,77	17,75	18,09
Sleeping/resting	45,73	47,44	69,97	84,64	28,33	37,20
Grooming	48,12	11,60	58,70	24,91	31,06	13,99
Exercising	18,09	12,97	21,16	17,06	10,58	12,97
Calling/texting	65,53	59,39	69,62	65,19	69,28	60,07
Social Media	60,07	59,39	81,23	80,55	51,54	52,90
Web Browsing	38,23	38,23	73,04	64,16	41,98	40,27

Figure 7. Percentage of preferred non-driving related activities (NDRA) in automated vehicles

The chi-square test of independence was conducted between the gender and the travel purpose with direction for every NDRA. All expected frequencies were greater than five, indicating that the minimum sample size to run this test has been achieved. Among those activities, only "interacting with others" has a statistical association between gender and travel purpose with direction, $X^2(5) = 46.857, p < 0.001$. No statistically significant association can be detected among other NDRA as their p-value were bigger than 0.05. Therefore, the null hypothesis can be rejected for "interacting with others" only, whereas other activities show that the variables were independent.

In addition, this analysis includes Cramer's V, which measures the strength of the association of a nominal-by-nominal relationship. Cohen [24] suggested that the Cramer's V value can be divided into three (3) segments: weak association (Cramer's V = 0.1), moderate association (Cramer's V = 0.3), and strong association (Cramer's V = 0.5). This test shows that all associations were small, Cramer's V < 0.3.

Table 3 shows the results of the chi-square test of independence and the value of Cramer's V of each NDRA, while **Table 4** shows the number of observed frequencies used in this chi-square test of independence.

In addition, most respondents increased their choices of NDRA when travelling with an automated vehicle compared to the non-automated vehicle. On average, the activity with the highest percentage increases from the non-automated vehicle to the automated vehicle was reading (24.57%), followed by eating or drinking (19.23%) and web browsing (16.61%). Other results of the comparison between the average percentage of NDRA in non-automated vehicles and the automated vehicle can be seen in **Figure 8**. The percentage shows the increment of every activity from non-automated to automated vehicles.

The difference between non-driving related activities in a non-automated vehicle and an automated vehicle can be easily distinguished (see **Figure 8**). All the activities received an increment from the non-automated vehicle to the automated vehicle in preference percentage. This data

suggests that Malaysians will have longer quality time spent during travel in the future of automated vehicles, as most of them did not hesitate to remove their focus on the road to perform other activities. This was mainly because 46% of the activities required users to use a personal device, and a total of 66% of the activities required a high focus level. Furthermore, smartphones are one of the devices that are widely used among Malaysians. According to Statista [25], 87.61% of the Malaysian population in 2020 own a smartphone, and this statistic shows that smartphone usage during travel in an automated vehicle will be a norm. This shows that Malaysians also have a high level of trust in machinery compared to several passengers from other countries that prefer not to use the automated vehicle [17].

Table 3. Chi-square test of independence and the value of Cramer's V

NDRA	Chi-square Test of Independence (Gender vs Travel Purpose with Direction)	Cramer's V
Interacting with others	$X^2(5) = 46.857, p < 0.001$*	0.195
Listening to music	$X^2(5) = 2.806, p = 0.730$	0.049
Watching road	$X^2(5) = 3.012, p = 0.698$	0.052
Eating or drinking	$X^2(5) = 2.696, p = 0.747$	0.051
Reading	$X^2(5) = 1.159, p = 0.949$	0.037
Working or studying	$X^2(5) = 1.199, p = 0.945$	0.049
Sleeping or resting	$X^2(5) = 4.841, p = 0.436$	0.073
Grooming	$X^2(5) = 1.319, p = 0.933$	0.049
Exercising	$X^2(5) = 5.889, p = 0.317$	0.147
Calling or messaging	$X^2(5) = 3.240, p = 0.663$	0.053
Social media	$X^2(5) = 2.922, p = 0.712$	0.051
Web browsing	$X^2(5) = 3.889, p = 0.565$	0.067

**Indicate significant association*

Table 4. Observed frequency between gender, travel purpose with direction, and NDRA

Gender	Travel Purpose and Direction						NDRA
	Work		Holiday		Daily Affairs		
	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	
Male	124	84	146	116	122	91	Interacting with other
Female	72	151	93	83	83	71	
Male	118	97	143	113	90	85	Listening to music
Female	88	76	96	97	77	75	
Male	102	73	149	129	90	74	Watching road
Female	85	63	106	92	83	65	
Male	96	67	148	140	62	71	Eating or drinking
Female	76	57	96	98	51	59	
Male	98	79	106	102	54	70	Reading
Female	65	51	72	64	42	41	
Male	97	67	32	30	30	32	Working or studying
Female	76	46	29	25	22	21	
Male	78	80	127	145	43	56	Sleeping or resting
Female	56	59	78	103	40	54	
Male	89	19	105	48	57	24	Grooming
Female	52	15	67	25	35	17	
Male	30	19	36	27	12	15	Exercising
Female	23	19	26	24	19	23	
Male	117	98	128	119	116	100	Calling or messaging
Female	75	76	77	72	87	76	
Male	105	102	141	140	82	82	Social media
Female	70	71	96	95	68	72	
Male	67	63	125	103	65	58	Web browsing
Female	44	48	88	84	57	59	

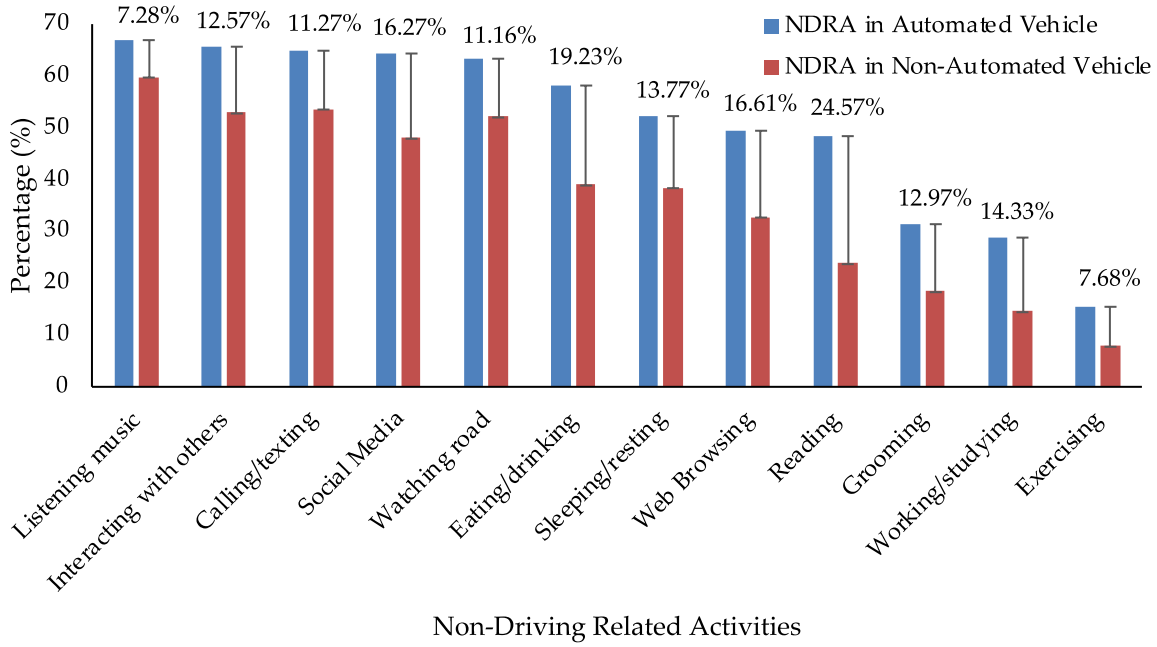


Figure 8. The average percentage of NDRA in automated vehicles and non-automated vehicles

However, the drawbacks that may prevent more users from performing high focus-level activities during automated driving are the trust level in the machine and motion sickness that will affect the takeover performance [26]. Regardless of the drawbacks, having a journey on an automated vehicle is a proven advantage to focus on NDRA safely among users from Malaysia and other studied countries. To ensure a good experience in performing NDRA during automated vehicle travels, developers need to consider a user- and NDRA-friendly design. This is important for the users as the rate to engage with NDRA will significantly increase in the automated vehicle compared to the non-automated vehicle, according to this study's and past studies' results. Besides, good quality and productive time can be fully utilised by users, especially among those who value time, such as business people and freelancers. Their travel time, especially among those who drive, as the data in Section 4.1 found that the average travel distance as a driver is 17,490 km, can be used to complete tasks. By highlighting the different abilities of an automated vehicle regarding NDRA, it will eventually encourage users to own the technology.

4.6. Extra Questions

4.6.1. Have you ever heard of automated vehicles before participating in this study?

This question was asked to investigate the respondents' familiarity with automated vehicles in Malaysia. The result shows that most respondents have already heard and are familiar with the automated vehicle concept before participating in this study. As a comparison with other countries, the result was tabulated in the following **Table 5**.

A chi-square test of independence was conducted between education level and familiarity with the automated vehicle. All expected frequencies were greater than five, except for PhD level education and School level for "No". There was no statistically significant association between education level and familiarity with automated vehicles, $X^2(4) = 8.039, p = 0.09$. The association was small [24],

Table 5. The result of automated vehicle familiarity between different countries

Response	Malaysia (Current study)	Schoettle & Sivak [17]						Wadud & Huda [11]
		China	India	Japan	The U.S.	The U.K.	Australia	Bangladesh
Yes	81.6	87.0	73.8	57.4	70.9	66.0	61.0	89.4
No	18.4	13.0	26.2	42.6	29.1	34.0	39.0	10.6

with Cramer's V = 0.166. There was no statistically significant association between the two variables. Therefore, the education level and familiarity of the automated vehicle are independent.

4.6.2. *Since Automated Vehicle travels from one location to another by themselves, do you think you will need extra information such as turning direction, obstacle ahead, traffic condition, etc., apart from the destination?*

The purpose of this question is to assess the need for extra information about the driving or surrounding situation during the journey of an automated vehicle. The result will be added data for automated vehicle developers during the designing process. The results show that most respondents (72.4%) would prefer to have the extra information, while 3.1% chose "No", and the remaining 24.6% were neutral. Based on the result, a system that can alert any hazard and supply information about the surrounding in real-time will be beneficial as most potential users will fully utilise the features. This feature will be more crucial when the automated vehicle passengers start to focus entirely on NDRA. Moreover, the additional live-feed information will improve the situation awareness, and hence it may reduce the motion sickness suffered by passengers while performing non-driving related activities [27]–[30].

4.6.3. *Which layout of the seating position inside an Automated Vehicle do you prefer?*

By referring to the seating configurations of an automated vehicle in **Figure 2** (see Section 3), the results of this question can be seen in **Figure 9**. The majority of the respondent prefers seating layout A (64.5%), followed by seating layout B (35.8%), seating layout C (28.7%), seating layout E (25.3%), and lastly, seating layout D (22.2%). From the result, most respondents still prefer a conventional seating layout compared to other new layout configurations even though the driving tasks have been eradicated. The results were affected by the fully automated vehicle still unavailable in the market to be used directly by the consumer. So, most respondents preferred something they already knew about rather than using new configurations that may create an uncomfortable situation. This situation is similar to the study by Östling and Larsson [22], where two of three tested scenarios received seating layout A as the most preferred choice.

5. Conclusion

In conclusion, the ability to perform non-driving related activities is an essential feature of automated vehicles. However, most non-driving related activities will produce motion sickness. To improve the experience in the most comforting situation, researchers need to discover the type of activities of a passenger to improve any automated vehicle design. Other researchers have already started investigating preferred non-driving related activities and found that every country has a different background of activities. It is vital to investigate the type of activities preferred by various localities as each solution may not suit everyone. This study was done to discover the Malaysian's preferred non-driving related activities during travel, which are "listening to music", "interacting with others", and calling or texting". In addition, several automated vehicle technologies were also asked to investigate suitable Malaysian features. With the

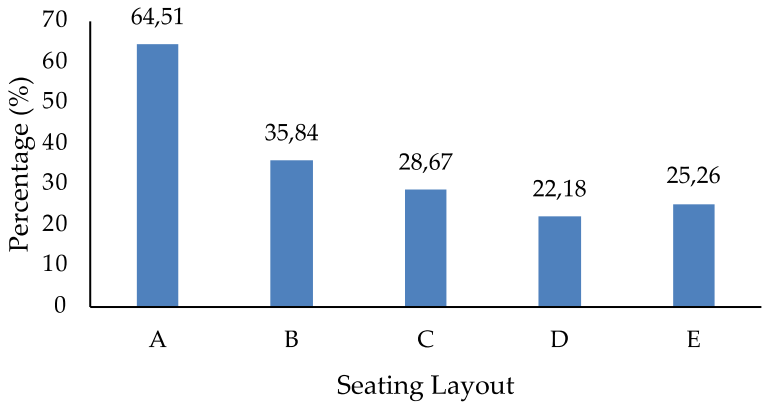


Figure 9. The percentage of the most preferred seating layout in the automated vehicle

results gained, Malaysian passengers' perspectives will not be overlooked during the transition process to automated vehicles. For future suggestions, a different approach to investigating the non-driving related activities, such as interviews and observations, can be made to validate the results further. Besides, increasing the number of respondents will significantly improve the accuracy of the results.

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Author's Declaration

Authors' contributions and responsibilities

The authors made substantial contributions to the conception and design of the study. The authors took responsibility for data analysis, interpretation and discussion of results. The authors read and approved the final manuscript.

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Competing interests

The authorsdeclare no competing interest.

Additional information

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