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A Classification and Preference Analysis of Interior Types of Autonomous Car

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Abstract

The degree of automation of autonomous vehicles is getting higher and higher, and with the increasingly fierce commercial competition of electric vehicles such as Tesla, the technology of autonomous vehicles will develop rapidly along with the commercial competition. Of course, changes in energy and the way autonomous cars drive will also change the demand for space in the car. Therefore, this paper aims to redesign the interior design of self-driving cars. The literature search and statistics show that the self-driving car's interior is divided into four categories according to the function type: work, entertainment, rest, and driving. The user's needs, behaviors, ideal facilities, and facility placement schemes in the self-driving car are obtained using focus group interviews and expert interviews. Then, 320 respondents were divided into Male and female ages; two groups were statistically compared and analyzed. The conclusion is that in work, entertainment, rest, and driving space, male and female 20-29 years old, 40-59 years old age group standard preference car features: Strong privacy, independent office, spacious office/entertainment area, sound and sound insulation effect, large screen area (car front windshield area plus ceiling are screens).

Keyword : self-driving car; in-vehicle space; in-vehicle facilities; preference

1. Introduction

More and more car dealers are joining the competitive environment of auxiliary driving cars. Commercial activities to assist in driving cars will promote the development of self-driving cars. As the behavior and requirements of the interior space change, so do the seat position and the activities of the original driver and passenger. This thesis aims to redesign the interior design while retaining the driving function according to the driver's and passenger's behavior/needs. Traditional car drivers are so restrictive to drivers that drivers can't do anything other than focus on driving. Passengers can only enjoy a fixed view from the angle of their seats. Entertainment has no more entertainment and interaction than music, video, and reading. The significance of this thesis lies in redesigning the traditional car space, adding

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more in-vehicle facilities, enriching the interaction behavior of the car personnel, and satisfying the needs of more in-vehicle personnel.

The research process investigates the automation classification of self-driving vehicles and the composition of the interior space of self-driving vehicles. After obtaining the functional classification of the interior space of a self-driving car, the user's needs, facilities, and functions are obtained by FGI [1] survey, and the specific internal placement preference is obtained by expert interview. The survey results on the location of the car's interior are sent to the Chinese mainland for a preference survey. After receiving the first-ranked case of each space, the male and female comparison and age comparison analysis were carried out. Finally, the characteristics of interior position preference of self-driving cars are summarized. [Table 1] is the research process of this paper.

[Table 1] Research process

<table>
<tr><td colspan="3">Theoretical Foundation</td></tr>
<tr><td>Self-driving car space type classification</td><td>Self-driving car interior facility preference</td><td>Self-driving car interior positioning</td></tr>
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2. Literature review

2.1 Self-driving car automation level

The degree of unmanned gradually automates with the increase of the level, and the change of the driving mode of automation will change the demand for space in the car. According to the literature query, autonomous driving is classified as level 0-5. The Lv0 level is fully human driving. The Lv1 level is auxiliary driving, the Lv2 level is partially autonomous driving, the Lv3 level is conditional

autonomous driving, the Lv4 level is highly autonomous driving, and the Lv5 level is fully independent. From the driver's point of view, the Lv0 level must complete all driving operations. The Lv1 level must conduct all moving operations but, in some cases, can be assisted. Lv2 vehicles can take on some basic driving tasks, but the driver must always be ready to take over the car. Level Lv3 Drivers must take over the car when the function is requested. Level Lv4 When the system is no longer operational, the driver must take over the vehicle upon notice. The Lv5 requires no driver, and the steering wheel is available. Everyone is a passenger in an Lv5 self-driving car [2].

[Table 2] Automation classification table for self-driving cars

	Lv 0	**Lv 1**	**Lv 2**	**Lv 3**	**Lv 4**	**Lv 5**
Degree	Full human driving	Assisted driving	Partial autopilot	Conditional autopilot	Highly autopilot	Fully autonomous driving
Driver	Must complete all driving operations.	All driving operations must be completed, but in some cases assistance is available.	The vehicle can take on some basic driving tasks, but the driver must always be ready to take over the car.	The driver must take over the car when the function is requested.	When the system is no longer operational, the driver is required to take over the vehicle upon notification.	No driver required, steering wheel available or not required. Everyone is a passenger in an L5 self-driving car.

[Table 2] shows that all Lv1-4 levels need car handling facilities (steering wheels), whereas Lv5 self-driving cars do not require steering wheels. However, trust in new technologies is expected to be a significant challenge for the public. Only some would be reassured using a unique, unproven transport technology [3]. This suggests retaining steering wheel functionality in fully automated vehicles is still necessary.

2.2 Self-driving car space type survey statistics

The literature describes interior space in a car in eight categories: living room, office, rest, entertainment, food, personal space, social, and driving [4-8]. Among the five-investigation literature, living room type is 3/5; office type is 4/5; rest type is 3/5; entertainment type is 2/5; food type is 2/5; personal space is 2/5; social type is 3/5; driving type is 1/5. [Table 3] collates the survey statistics of the space types of autonomous vehicles.

[Table 3] Self-driving car space type survey statistics

	Kwon J Y, Ju D Y (2018)	Altun. K (2018)	Hirte G, Laes R (2022)	Wilson C, Gyi D (2021)	Sun X, Cao S, Tang P (2021)
Live room	●	●			●
Office	●	●	●		●
Rest	●			●	●
Entertainment	●	●			
Food		●			●
Space personal		●	●		
Socialize	●	●			●
Drive					●

The proportion of office types was up to 4/5; the proportion of living room type, rest type, and social type was 3/5; the proportion of entertainment type, food type, and personal space was 2/5; and finally, driving type was 1/5. Living room and rest type functions overlap and can be divided into one type; social and entertainment type functions overlap and can be divided into one type. Food and personal space types can be applied to any space, so they are no longer divided into separate categories. Although driving types account for the lowest proportion, combined with the survey of autonomous vehicle automation levels, retaining the steering wheel function of Lv5 self-driving cars is still necessary. Audi has released a concept car that can accommodate a steering wheel [9]. Therefore, the types of driving are divided into separate categories. Therefore, self-driving car interior decoration can be divided into office type, entertainment type, rest type, and driving type.

3. Method of investigation

3.1 Purpose and objectives of FGI investigation

The first focus group interview discussed passengers' needs, behaviors, and facilities in self-driving car spaces. The survey period is May 23, 2023. Four male subjects are divided into groups, and four are UX Ph.D. [10] members. Remarks: The focus group interviews were all male and had a slight age span. To get more accurate information about user surveys, women, older age spans, and more will be included in the following expert interview. [Table 4] is a summary of FGI survey objectives and objects.

[Table 4] Organization of FGI survey objectives and targets

	Focus group interview	Additional Information
Period	23 May, 2023	
Survey object	Four of the four respondents were men. In a group, all four of the subjects were UX PhD members.	The focus group interviews were all male and had a small age span. To get more accurate information about user surveys, women, older age spans and more will be included in the next expert interview.
Purpose	Discuss the needs, behaviors and facilities of passengers in self-driving cars.	

3.1.1 FGI Investigation Questions

The age range of the FGI questionnaire was 32-37, and the mean and median were 34.5 years. The driving age range is 7-18 years, and the average and median are 12.5 years. The ambitious preference level is 1-5, and the middle and median are 3. The investigation question revolves around what facilities are needed for this space. Why do you want this facility, and how will you use it? Will you use this facility with other people? How many people? Who are you going to use the facility with? Expand. [Table 5] is a summary of FGI survey questions.

[Table 5] FGI Investigation Questions

Process	Survey questions
lcebreaker	Survey of respondents' names, gender, age, driving age, and driving preference rating.
User needs survey	What facilities do you want in this space?
	Why do you want this facility?
	How will you use these facilities?
	Would use the facility with others ? How many people?
	Who do you plan to use the facility with?

3.1.2 Results of FGI Questionnaire

In terms of user needs, the main facilities are desk/functional flat screen, TV/computer/screen/keyboard/ceiling screen, seat/bed, steering wheel/pedal; secondary facilities are network facilities (Wi-fi, net tray), printer, water dispenser, shredder. All four respondents said they usually use the facilities with family or friends. The interaction was between sitting and lying, with several 2-3 intervals. These facilities are mainly used for meetings, relaxation, games, parties, sleep, body feeling, and environmental atmosphere. The functions that respondents want are office function, web conference function, offline office function, game function, video/music function, food/article storage function, massage function, wake/sleep guide function, anti-sickness feature. [Table 6] is the collation of

FGI survey results.

[Table 6] Results of FGI Questionnaire

Classification		User needs
Elements	Main	Table/Functional plane, TV/Computer/Screen/Keyboard/Ceiling screen, Seat/Bed, Steering wheel/Pedal.
Contents	Behavior	Sit and lie down.
	Object	Myself, family, friends.
	Number of people	with 2-3 objects.
	Activities	Meetings, relaxations, games, parties, sleep, health, physical, environmental atmosphere.
	Result	Office functions, Web Conference function, Off-line Office function, game function, Video/Music function, Food/storage function, massage function, Wake/Sleep Induction function, Anti-Sickness Function, Bathing function, Body Sensing Function, Smell/Light function, private space function, Bedroom Features function, Health & Wellness function, voice interaction function, Adjust driving mode function, Early Warning System Function, traffic information function, Maneuverable human-computer interaction platform.

3.2 Expert Interview Purpose and Objectives of the Survey

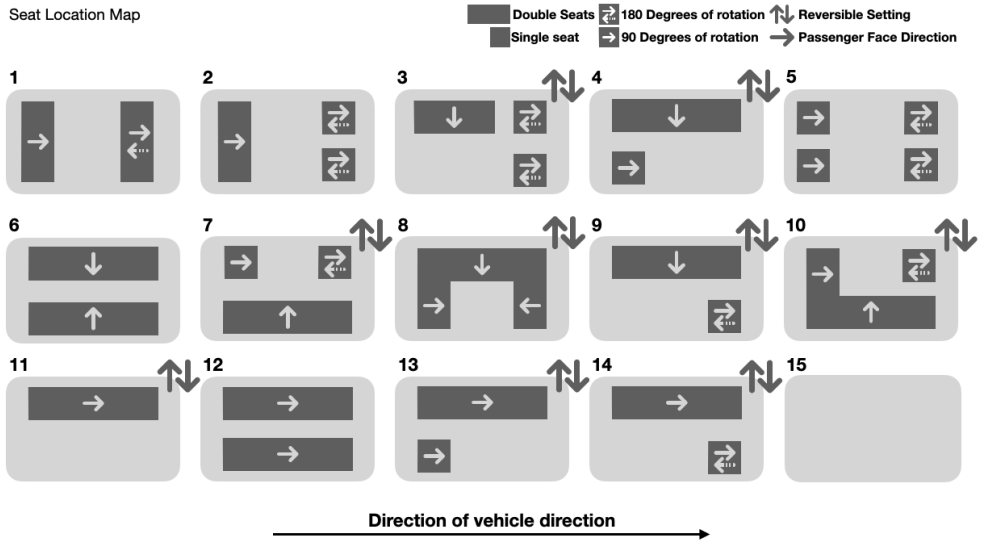
The second expert interview aimed to discuss specific facilities and location preferences for self-driving car spaces. The survey period is from September 20 to 21, 2023, with eight people, four men and four women, and 8 UX PhD. Two male UX Ph.D. members participated in the first FGI survey. So, this expert interview has six more members than last time. Of the six experts, four were women, and two were men. [Table 7] is the sorting out of the purpose and objects of the expert interview survey.

[Table 7] Purpose and objectives of the expert interview survey

	Expert Interview	Additional Information
Period	20 September - 21 September 2023	
Interviewee	A total of eight people were surveyed, four of whom were men and four were women, and eight were all UX PhD personnel.	Two male UX PhD members participated in the first FGI survey. The expert interview was six more members than the previous one. Of the six experts, four were women and two were men.
Purpose	Location preference survey of specific facilities for self-driving vehicle space types per expert	

3.2.1 Expert Interviews Questions

The average age range of the interview was 32.5 years, and the median age was 32 years. The driving age range was 2-10 years, with an average of 6.5 years and a median of 7.5 years. The driving preference level is 1-5, with an average of 3.25 and a median of 4. In this interview, 14 seats were arranged, and one blank chart was used as a questionnaire. [Fig. 1] is the location survey diagram.



[Fig. 1] Seat position map

Respondents chose five types of questionnaires for each space, four from the main facility options and one to four from the secondary facility options in the FGI results form. (5-8 facilities per space on average). The interview question is: Where would you place the selected facility in the car space? In addition to the facilities listed in the FGI survey results form, what other facilities do you prefer? Do you have other options besides the 14-seat placement options in the questionnaire? [Table 8] is the sorting out of expert interview questions.

[Table 8] Expert interview questions

Process	Survey questions
Icebreaker	Survey of respondents' names, gender, age, driving age, and driving preference rating.
Expert Advice Survey	A questionnaire was used with 14 seats and 1 blank chart. Respondents selected 5 types of facilities selected in the FGI survey results form for each space questionnaire.
	Respondents will choose four of the main facility options and one to four of the secondary facility options in the FGI questionnaire. (5-8 facilities per space on average).

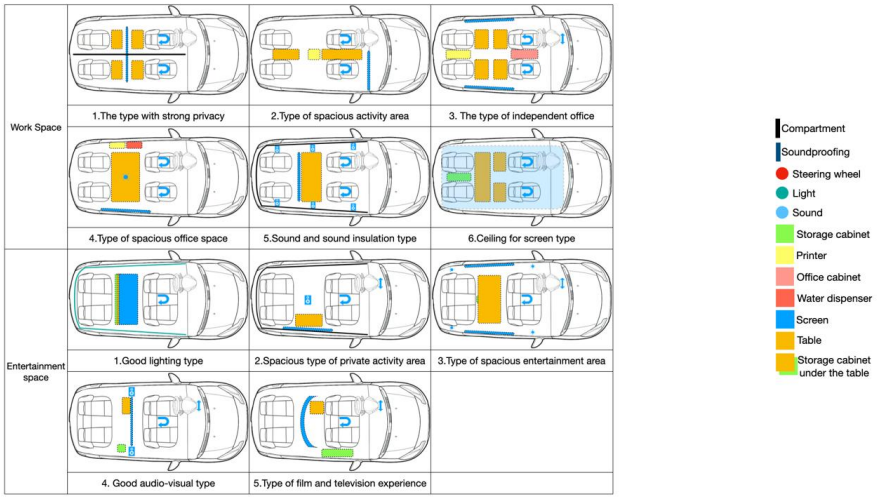
	Where would you like to place the selected facility in the car space?
	What other facilities do you like besides the FGI survey results form?
	Do you have any other options besides the 14 seat placement options listed in the questionnaire?

3.2.2 Expert Interviews Survey Results Statistics

The statistics show that the number 5 type of workspace has the most choices, the number 6, the number of entertainment space has the most choices, the number 5, and the number of rest space has the most choices, respectively, 9 and 12. The most frequently selected driving space is type 1, with seven times. [Table 9] is the statistical collation of expert interview results.

[Table 9] Statistics of the results of expert interviews

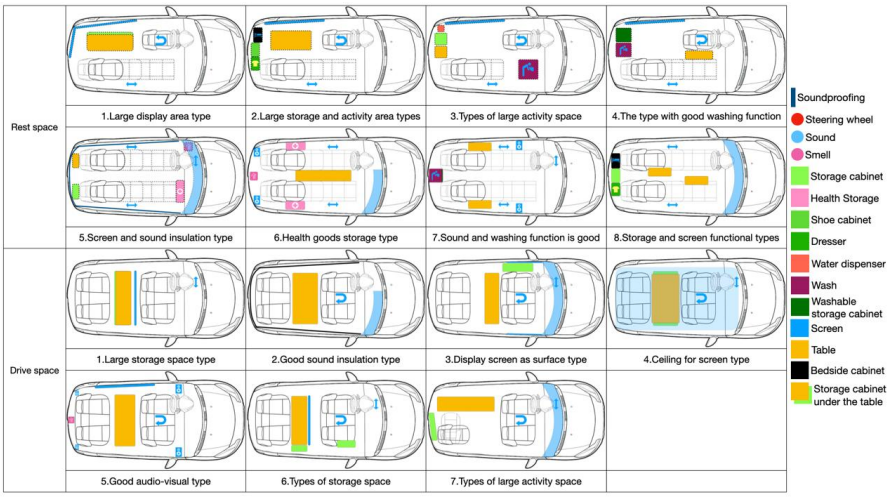
Work space	Type	5	2/8	1/7/10	3/11/14/15	6/9/13/16	4/12	
	Times	6	5	4	2	1	0	
Entertainment space	Type	1	2/5/7/15	3/8/10/11/14	13	9/12	4/6/16	
	Times	5	4	3	2	1	0	
Rest space	Type	9/12	1/6/7/8/11/14/15	2/3/4/10/13	5	16		
	Times	4	3	2	1	0		
Drive space	Type	1	3	5/15	2/7	10	9/11/12/13/14/16	4/6/8
	Times	7	6	5	4	3	1	0



[Fig. 2] There are 6 types of workspaces and 5 types of entertainment spaces

The number of first-place choices per space represents the number of design options. There are six

types of workspaces: 5 types of entertainment spaces, eight types of rest spaces, and seven types of driving spaces. [Fig. 2] and [Fig. 3] are the specific interior layout and characteristics of each space type.



[Fig. 3] There are 8 types of rest spaces and 7 types of driving spaces

3.3 Purpose and objectives of the preference survey for self-driving car interior arrangement plan

This survey determines the preference and comparative analysis of the interior arrangement of self-driving cars. The survey was conducted from October 7-8, 2023, targeting 320 users in mainland China, including 80 men and 80 women aged 20-29. There are 80 men and 80 women in the 40-59 age group, totaling 160. The sample size was 12.3 times larger than the questionnaire, except for Tibet, Qinghai, and Ningxia in mainland China. [Table 10] is the purpose and object of the survey of interior layout preference for autonomous vehicles.

[Table 10] Purpose and object of the preference survey for self-driving car interior layout scheme

<table>
<tr><td></td><td colspan="4">Investigation</td><td>Additional Information</td></tr>
<tr><td>Period</td><td colspan="4">October 7th to October 8th, 2023</td><td></td></tr>
<tr><td rowspan="5">Survey object</td><td colspan="2">Contect</td><td>Frequency(N)</td><td>Total(N)</td><td rowspan="5">The sample size was about 12.3 times that of the questionnaire, except Tibet, Qinghai and Ningxia in mainland China.</td></tr>
<tr><td rowspan="2">Gender</td><td>Male</td><td>160</td><td rowspan="4">320</td></tr>
<tr><td>Female</td><td>160</td></tr>
<tr><td rowspan="2">Age</td><td>20-29 years old</td><td>160</td></tr>
<tr><td>40-59 years old</td><td>160</td></tr>
<tr><td>Purpose</td><td colspan="5">Preference Survey and Comparative Analysis of Interior Decoration Schemes for Self-driving Cars</td></tr>
</table>

3.3.1 Preference survey on interior layout of self-driving cars

The respondents scored, according to the survey results of the expert interview, from 1 to 5; the favorite was 5, and the least favorite was 1. (Type picture is the top view of the vehicle). 1-6 What is the score for each type of facility placement survey in favor of workspaces? 7-11 Question: How many points do you have for each type of facility placement survey? 12-19 What is the score for each type of facility placement survey in favor of rest areas? 20-26 Question: What is the preference for each type of facility placement survey in favoring driving spaces? Question 27: is your sex? Question 28: is your age? [Table 11] is a survey of preferences for the interior layout of autonomous vehicles.

[Table 11] Preference survey on interior arrangement of self-driving cars

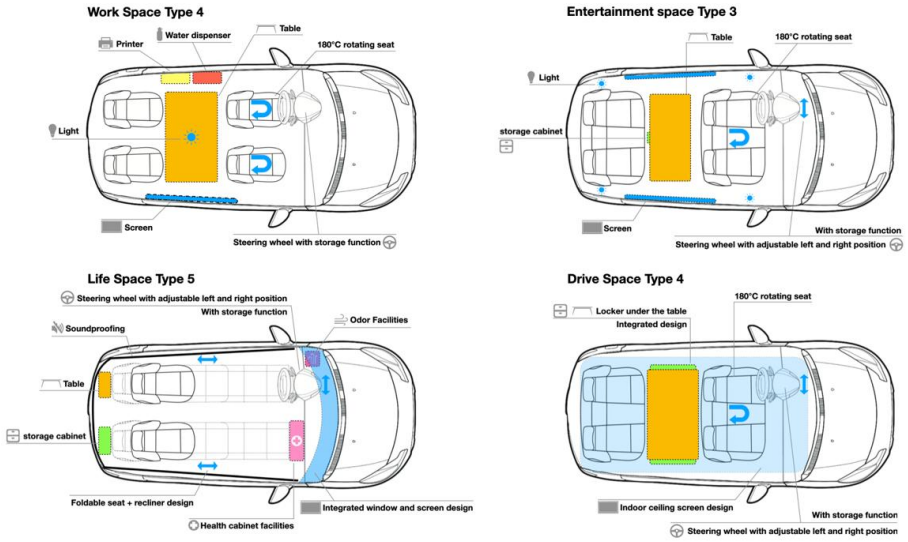
Process	Survey questions
User preferenc e survey	The respondents scored according to the type of space, ranging from one to five, five for the favorite and one for the least favorite. (Type picture is the top view of the vehicle)
	1-6 What is the score for each type of facility placement survey in favor of workspaces?
	7-11 Question: What is the preference for the placement of facilities in entertainment spaces?
	12-19 What is the score for each type of facility placement survey in favor of rest areas?
	20-26 Question: What is the preference for each type of facility placement survey in favoring driving spaces?
	Your sex?
	Your age?

3.3.2 Preference Survey Results for Interior Decoration of Self-Driving Vehicles

Of the 320 respondents, the highest score was for each space type, workspace type 4, with a score of 3.81. Driving Space Type 4 with a score of 3.72. Entertainment Space Type 3 with a 3.68. Rest Area Type 5 with a 3.67. Working space type 4 features spacious office space, entertainment space type 3 features spacious entertainment area, lounge space type 5 features good screen and soundproofing, and driving space type 4 features ceiling screen.

Summary: The program features with the highest score for each space type can be summarized as functional areas, large screen areas, and good sound insulation. [Fig. 4] is the scheme with the highest score among the four spatial types among the 320 respondents.

The average score of the program type in a workspace is about 3.74, the average score of the program type in the driving space is about 3.63, the average score of the program type in the recreation space is about 3.49, and the average score of program type in the resting space is about 3.48.



[Fig. 4] The program with the highest score for each space type out of 320 respondents

Summary: The highest average number of workspaces indicates that the interviewees preferred one type of design. The average number of driving spaces is second high, again is the rest space, and finally is the entertainment space. The difference between the average scores for recreational and rest spaces and between 0.14 and 0.15 for driving spaces suggests that the two space-type schemes were unfavorably compared to the working and driving spaces. [Table 12] is the survey result on the preference for the interior placement scheme of autonomous vehicles.

[Table 12] Preference survey results of interior layout of self-driving vehicles

Work space	Type	1	2	3	4	5	6		
	score	3.73	3.64	3.79	3.81	3.75	3.73		
Entertainment space	Type	1	2	3	4	5			
	score	3.62	3.27	3.68	3.39	3.5			
Rest space	Type	1	2	3	4	5	6	7	8
	score	3.13	3.44	3.43	3.5	3.67	3.59	3.48	3.63
Drive space	Type	1	2	3	4	5	6	7	
	score	3.61	3.7	3.68	3.72	3.55	3.61	3.57	

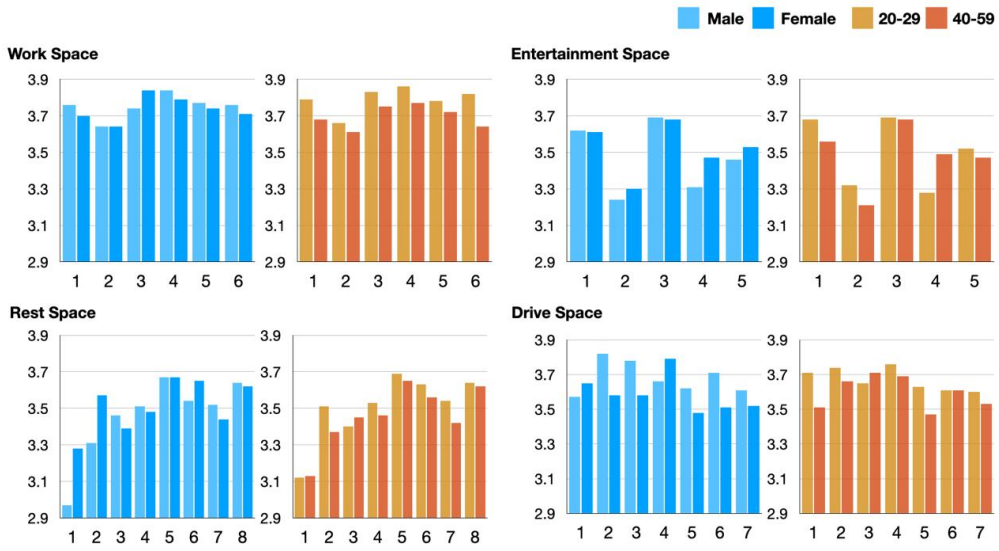
3.4 Analysis of results of gender and age comparison survey

The proportion of men and women surveyed was 50 percent for men and 50 percent for women. The age comparison was set to two; one was 50 percent in the 20-29 age group, and the other was 50

percent in the 40-59 age group. Combined with all 320 respondents mentioned above, 3.67 of the highest spatial score was the lowest. Therefore, each spatial type of program in the male and female comparison score, age comparison score, higher than 3.67 program-specific analysis.

Among the male interviewees, the space with a score of 3.67 or higher was workspace 1, 3, 4, 5, 6. Entertainment space type 3, rest space type 5, driving space type 2, 3, and 6.Among the female interviewees, the space with a score higher than 3.67 and the workspace types 1, 3, 4, 5, and 6.Entertainment space type 3, rest space type 5, driving space type 4. In the 20-29 age group, the space of the interviewees was higher than 3.67, and the working space types were 1, 3, 4, 5, and 6. Entertainment space types 1 3, rest space types 5, driving space types 1, 2, and 4. In the 40-59 age group, the space of the interviewees was higher than 3.67, and the working space types were 1, 3, 4, and 5. Entertainment space type 1, 3, rest space type 5, driving space type 3, 4.

Summary: The standard programs with scores higher than 3.67 for both the male and female respondent groups were Workspace No.1 type of solid privacy, three types of independent office, four types of spacious office areas, five types of good sound and sound insulation effect, six types of ceiling screen, entertainment space three types of spacious entertainment area, rest space No.5 type of screen and sound insulation effect. Only the driving space type differed, with male respondents preferring type No.2 with good soundproofing, type No.3 with curved display screen, and type No.6 with more storage space. Women like the type of ceiling No.4 for the screen.



[Fig. 5] Results of gender and age comparison survey

In the 20-29 age group and the 40-59 age group, the standard plan with a score higher than 3.67 was: Workspace type No. 1 type of solid privacy, No. 3 type of independent office, No. 4 type of spacious office area, No. 5 type of good sound and sound insulation effect, entertainment space type No. 1 type of good lighting, No. 3 type of spacious entertainment area, rest space type No. 5 screen and sturdy insulation effect type, driving space type No. 4 ceiling screen class Type. The different schemes are: Working space No. 6 is the type of screen ceiling, driving space No. 1 is the type with ample storage space, and operating space No. 2 is the type with good soundproofing. Drive space 3: The display screen is the curved surface preferred by the 40-59 age group. [Fig. 5] is a comparison of males and females and a comparison of age.

4. Conclusion

In conclusion, this study classifies the degree of automation of self-driving cars and learns that there are five levels of automation. The need to retain the steering wheel facilities of the lv5 level of self-driving cars still exists. According to the literature and statistics of functional classification, the interior space of a self-driving car can be divided into working space, entertainment space, rest space, and driving space. The survey method first obtained the user needs, primary/secondary facilities, behavior, target, number of people, activities, and desired functions of self-driving car interiors in the form of an FGI questionnaire. The FGI results' primary/secondary facilities and functions were selected as options in the expert interview survey, allowing the respondent to draw specific placement in the 14 in-vehicle seating diagrams and two blank in-vehicle seating diagrams. The results were six programs for working spaces, five for recreation spaces, eight for resting spaces, and seven for driving spaces. According to the preference survey of placement plan in expert interviews, the first place in the sample survey of 320 people was type 4 of workspace, type 3 of entertainment space, type 5 of rest space, and type 4 of driving space. According to the characteristics of each type of solution, the interior space can be summarized as an office/entertainment area, screen area (car windshield area plus ceiling is screens), and soundproof type. The characteristics of male and female groups, 20-29 and 40-59 age groups, are privacy, independent office, spacious office/entertainment area, sound and sound insulation, large screen area (car windshield area plus ceiling), and storage space.20-29 years old, 40-59 years old shared preferences are privacy, independent office, office/entertainment area spacious, sound and sound insulation, lighting, large screen area (car windshield area plus ceiling are screens), ample storage space type.

Conclusion: The car's characteristics in the work, recreation, rest, and driving space are privacy, independent office, spacious office/entertainment area, sound and sound insulation, and large screen area (the windshield area plus ceiling are screens).

References

[1] T. George, “What is a Focus Group Step-by-Step Guide & Examples”, scribbr.com, https://www.scribbr.com/methodology/focus-group, (accessed June 22, 2023).

[2] On-Road Automated Driving Committee, “Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles”, sae.org, https://saemobilus.sae.org/content/J3016_202104, (accessed December 25, 2021).

[3] P. Szikora, N. Madarasz, “Self-driving cars - The human side”, 2017 IEEE 14th International Scientific Conference on Informatics, November 14-16, 2017, Poprad, Slovakia, pp. 383-387, doi: 10.1109/INFORMATICS.2017.8327279.

[4] J. Y. Kwon, D. Y. Ju, “Interior Design of Fully Autonomous Vehicle for Emotional Experience: Focused on Consumer's Consciousness toward In-Vehicle Activity”, Korean Society for Emotion and Sensibility, vol. 21, no. 1, March 2018, pp. 17-34, doi: 10.14695/KJSOS.2018.21.1.17.

[5] K. Altun, R. O. Berber, R. Kurt, E. Bekta, S. Turan, V. Korkmaz, “Front seat development for autonomous driving: A case of innovative product development”, Journal of the Faculty of Engineering and Architecture of Gazi University, vol. 37, no. 3, February 2022, pp. 1441-1452, doi: 10.17341/gazimmfd.936325.

[6] G. Hirte, R. Laes, R. Gerike, “Working from self-driving cars, Transportation Research Part A: Policy and Practice”, vol. 176, no. 0965-8564, Article. 103785, October 2023, doi:10.1016/j.tra.2023.103785.

[7] C. Wilson, D. Gyi, A. Morris, B. Robert, H. Tanaka, “Space utilisation and comfort in automated vehicles: A shift in interior car design?”, Comfort Congress 2021, September 2-3, 2021, Nottingham, England, pp. 47-52.

[8] X. Sun, S. Cao, P. Y. Tang, “Shaping driver-vehicle interaction in autonomous vehicles: How the new in-vehicle systems match the human needs”, Applied Ergonomics, vol. 90, no. 0003-6870, Article. 103238, January 2021, doi: 10.1016/j.apergo.2020.103238.

[9] J. Edkins, “Audi Grand Sphere concept previews electric A8 replacement”, carwow.co.uk, https://www.carwow.co.uk/audi/news/5573/audi-grand-sphere-concept-ev-electric-a8-replacement-price-specs-release-date#gref, (accessed December 13, 2022).

[10] M. Bennett, “What is a PhD?”, findaphd.com, https://www.findaphd.com/guides/what-is-a-phd, (accessed November 1, 2023).