International Journal Of Engineering Research And Development
e- ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 20, Issue 12 (December, 2024), PP 07-16

Study on the Influence of Gender, Ecological Norms, and Habits on the Selection of Transportation Modes

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ABSTRACT
This research examines the correlation between women's modal choices and ecological norms, car usage habits, and their willingness to reduce car usage. A survey was conducted among the Jabodetabek (Jakarta, Bogor, Depok, Tangerang, Bekasi) community, yielding 403 valid responses. The hypothesis under investigation posits that women's willingness to reduce car usage is influenced by their ecological behavior and car usage habits. Data were analyzed using the Spearman Correlation method in SPSS. The results indicated that women's modal choices are not significantly correlated with their ecological norms or car usage habits, nor is their commitment to reducing car usage correlated with gender.

Date of Submission: 24-11-2024 Date of Acceptance: 04-12-2024

I. INTRODUCTION

Based on preliminary observations conducted in this study, it was noted that female passengers significantly outnumber male passengers during morning and evening rush hours at the Adam Malik Transjakarta Busway Stop. Although a formal census of passengers has not been conducted, this dominance is visually apparent. The higher proportion of female passengers may be influenced by societal norms, gender-specific characteristics, or prevailing paradigms.

Several factors are hypothesized to contribute to the pattern of women favoring public transportation. Historically, in certain regions, women were prohibited from driving, as was the case in Saudi Arabia. Until June 2018, Saudi Arabia was the last country in the world that prohibited women from driving. The ban was a major symbol of gender inequality. The lifting of the ban was a result of extensive advocacy by women's rights activists and was part of broader reforms under Crown Prince Mohammed bin Salman's Vision 2030, which aims to modernize the country and boost women's participation in the workforce [1],[2]. Since the ban was lifted, many Saudi women have taken to driving, which has improved their mobility significantly. This change is also helping the government reach its goal of increasing female workforce participation to 30% by 2030. Women now have more autonomy in running businesses and accessing job opportunities that were previously difficult due to the need for male guardians or chauffeurs [1],[2].

Noted that in Germany in 1991, only 35% of women were registered drivers, compared to 70% of men [1], a similar trend was observed in Switzerland, where the percentage of men using and owning cars was twice that of women. Women are often categorized as "captive riders," a group that relies on public transportation not by choice, but due to a lack of alternatives.

The second reason that may explain why public transportation users are now women is because women care more about environmental issues and have a stronger feeling to live in a more environmentally friendly style. Research shows that women tend to be more concerned about environmental issues and adopt more environmentally friendly behaviors, actions to reduce environmental impact compared to men.

As Davidson and Freudenburg write, women are generally more concerned about environmental issues related to environmental risks, such as nuclear energy and waste. Health and safety are important to women, and therefore women have a higher level of concern than men with respect to certain levels of environmental risks [9].

Women are more willing to take action to protect the environment in the domain of consumer behavior, for example, switching products for ecological reasons, buying products for ecological reasons[10], and more willing to pay more for environmentally friendly products[9], buying products because of lower pollution effects, buying products in recyclable containers rather than taking political action to save the environment, for example signing petitions, joining the community to save the environment [10].

The focus of this study is to analyze the relationship between eco-friendly behavior (ecological norm) and the choice of travel mode, it is important to note that in the research cited above, one of the bases of this study is that previous studies reveal that more environmentally friendly actions are taken/carried out by women if it is

related to their daily behavior. This indicates that women may have different concepts or patterns regarding environmentally friendly behavior, rather than taking political steps, women prefer to change their daily behavior in a more environmentally friendly direction. For this study, previous research is considered sufficient to hypothesize that women's mobility behavior that is more environmentally friendly than men's may be a reflection of their greater concern for the environment than men.

The third possible explanation of women's ecological travel behavior arises when we consider the concept of habits, which proves to be a relevant factor in explaining the choice of travel mode. Verplanken et al write that travel in most cases has a strong repetitive character (e.g., making the exact same commute to work in the same conditions and in the same way every morning) and therefore in such situations it is not driven by a deliberate decision but is habitual.

Many daily activities that people perform effortlessly stem from habit or repetition. The concept of habits suggests that current behaviors are rooted in past experiences. In the context of this study, when considering travel mode choices, individuals who frequently travel in similar situations are more likely to maintain a driving habit than those whose travel patterns vary (e.g., sometimes driving, sometimes using public transportation). Historically, women faced more driving restriction, which resulted in fewer opportunities to develop strong and consistent car-use habits. As a result, it can be inferred that women may have formed weaker driving habits compared to men.

Based on the above explanation, the problem proposed in this study is: are ecological norms (concern for the environment) and driving habits correlated with willingness to reduce car use among women? This work was inspired by Matthies, et al (2002) with some modifications in statical procedures [3].

No previous researcher in Indonesia has been involved in Civil Engineering, particularly Transportation, which has examined the link between gender and the willingness to reduce car use which is hypothesized to be influenced by ecological norms (environmental concerns) and driving habits that ban on women may form with a willingness to reduce car use.

Therefore, the novelty that is also the focus of this study is to examine ecological norms (concern for the environment) and driving habits that may be formed due to the prohibitions on working women in Jakarta with the willingness to reduce the use of cars.

II. MATERIAL AND METHODS

To collect data in this study, an online survey consisting of 5 parts was used that were arranged hierarchically. This research questionnaire is adapted from Matthies and Klockner [3]. The first part is an introduction that tells the purpose of this survey and tells the appropriate respondent criteria, aged between 17 - 65 years old (male or female), live in Greater Jakarta, and have a private car available to support the daily trip. The first part of the questionnaire is an introduction that tells the purpose of this survey and tells the appropriate respondent criteria; aged between 17 - 65 years old (male or female), live in Greater Jakarta, Bogor, Depok, Tangerang and Bekasi city and have a private car available to support the daily trip.

The second part is consists of five (5) questions about demographic characteristics, regarding gender, age, domicile, occupation and monthly income. The third part consists of 3 sub-sections, each of which asks about ecological norms, habit strength, and willingness to use urban public transportation as known from the respondents' questionnaire answers.

a. The ecological norm for reducing the use of cars was assessed with a statement provided (see in the appendix) and respondents gave a point on whether the statement did not describe them at all (point 1) to strongly describe themselves (point 5).
b. The strength of the habit of using a car is assessed by the way respondents are asked to choose to use their car or public transportation for some of the available activities (for example, visiting friends in other nearby cities), the information provided is very little, so that the answers given by the respondents are based on their habits so far. Respondents were asked to answer the vehicle that first appeared in their heads spontaneously. The strength of the habit of using a car is judged by the large number of answers using a car.
c. Meanwhile, the willingness to reduce the use of cars is assessed in the last sub-chapter. There were 6 situations in which respondents were asked to choose one statement regarding their preference between urban public transportation versus cars. By summarizing the answers, we got a preference ranking that varies between 6 (always definitely a car) and 36 (always definitely urban public transport)

The Effect of Gender on the Will to Reduce Car Use, Ecological Norms and Car Usage Habits

The hypothesis in this study was examined with statistical software with a correlation test between:

a. Gender and ecological norm
b. Gender and car habits strength
c. Gender and willingness to reduce car use

III. RESULT AND DISCUSSION

3.1 Respondent Characteristic

This study involved participants living in Jakarta, Bogor, Depok, Tangerang and Bekasi, respondents outside the area could not fill out the survey, the youngest respondent was 17 years old and the oldest was 65 years old, respondents had to have a car and driver's license. Finally, there were 29 respondent data issued, and 404 respondents whose data was used. Of the 404 respondents, 55.8% were women and 44.2% were men, the majority were domiciled in Jakarta and Tangerang, the majority worked in the private sector.

Table 1: Demographic Characteristics

	Frequency	**Percent**
Gender:		
Women	225	55.8
Men	178	44.2
Age:		
17-25 me	128	31.8
26-35 me	112	27.8
36-45 me	56	13.9
46-55 me	91	22.6
56-65 me	16	4
Domicile:		
Jakarta	157	39
Bogor	18	4.5
Depok	21	5.2
Tangerang	146	36.2
Bekasi	61	15.1
Occupation:		
Looking after home or family	33	8.2
Civil servant, military, police	24	6
Private sector employee	239	59.3
Entrepreneur	24	6
Student	83	20.6
Monthly income:		
Less than IDR 1 mio	60	14.9
IDR 1 million - IDR 4 million	101	25.1
IDR 4 million - IDR 8 million	116	28.8
IDR 8 million - IDR 12 million	68	16.9
More than 12 mio	58	14.4

Source: data recapitulation

3.2 Attachment to Ecological Norms

Among the five statements concerning ecological norms, the mean response was 3.7965, which, when rounded, becomes 4. This indicates that, on average, the respondents generally agreed that the statements were representative of their own behavior. There were respondents who answered with points 1, 2, 3, 4 and 5 as seen

in Table 2, the minimum and maximum parts. Figure 1 shows the frequency of answers for each statement given on the questionnaire.

Table 2: Descriptive Statistics of Ecological Norm

	N	Min	Max	Mean		Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Std. Error
Statement 1	403	1	5	3.7568	0.05742	1.15273	-0.464	0.122
Statement 2	403	1	5	4.1414	0.04733	0.95017	-1.02	0.122
Statement 3	403	1	5	3.4665	0.0533	1.07006	-0.035	0.122
Statement 4	403	1	5	3.6675	0.05279	1.05971	-0.313	0.122
Statement 5	403	1	5	3.9504	0.0511	1.0258	-0.706	0.122
Mean				3.7965				

Source: SPSS output

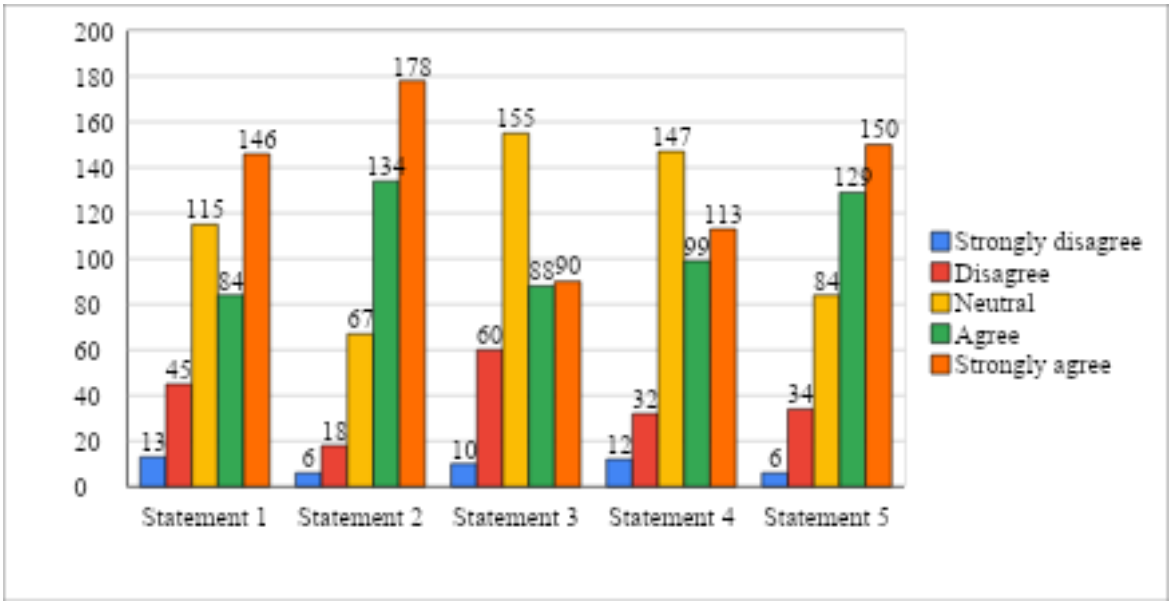

Figure 1. Frequency of answers to statements related to ecological norms

3.3 The Strength of Car Usage Habit

The results of the data recapitulation regarding the respondents' habits in using cars can be seen in Figure 2. 3 out of 5 activities asked, most of the respondents chose to use a car, while for the other 2 activities respondents preferred to use an Urban Public Transportation (UPT), as shown in figure 2. If totaled from all activities, then 54% of the answers were using cars and 46% were using TUP as seen in Figure 3. Meanwhile, looking further at the gender difference, 55% of the answers to using a car come from women, and 45% of the answers to using a car come from men, at first glance it can be seen that women have a stronger habit of using their cars than men even though there is only a difference of 10%.

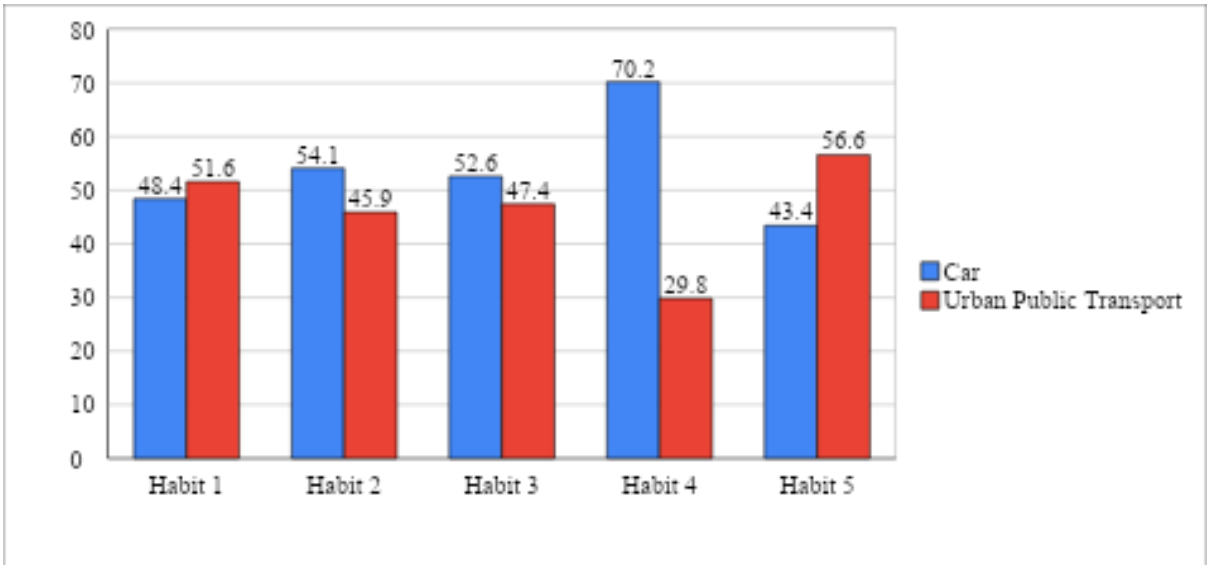

Figure 2. Habit of using mode for inspected activities (%)

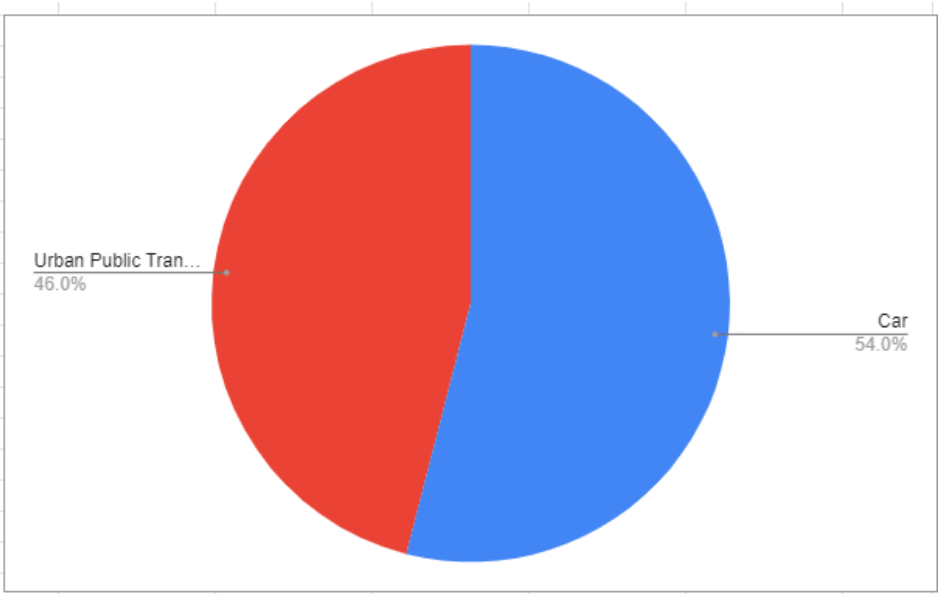

Figure 3. Percentage of mode usage habits for all monitored activities

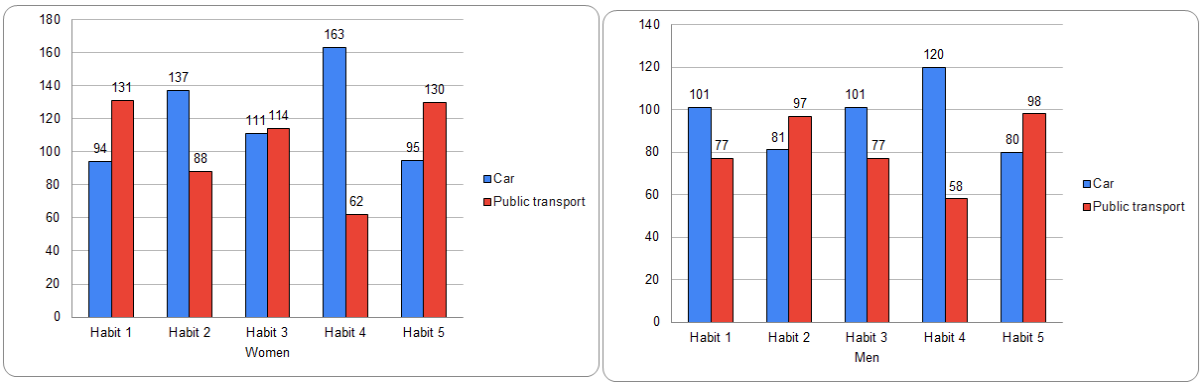

Figure 4. Distribution of female and male vehicle selection for each habit

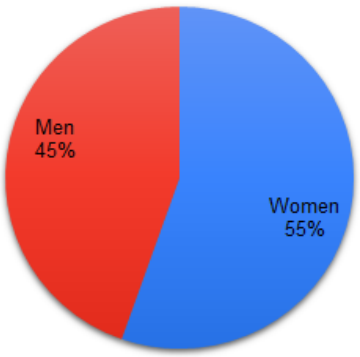

Figure 5. The percentage of car habits for all habits is seen from a gender perspective

3.4 Willingness to Reduce Car Usage

Figure 7 summarizes the answers of 403 respondents regarding the willingness not to use a car, it can be seen that the majority of respondents (118 people) answered option 5 (I may use urban public transportation/UPT) to the question asked to them about the possibility of the mode chosen for tomorrow (see attachment), which ensures that 62 people will use urban public transportation.

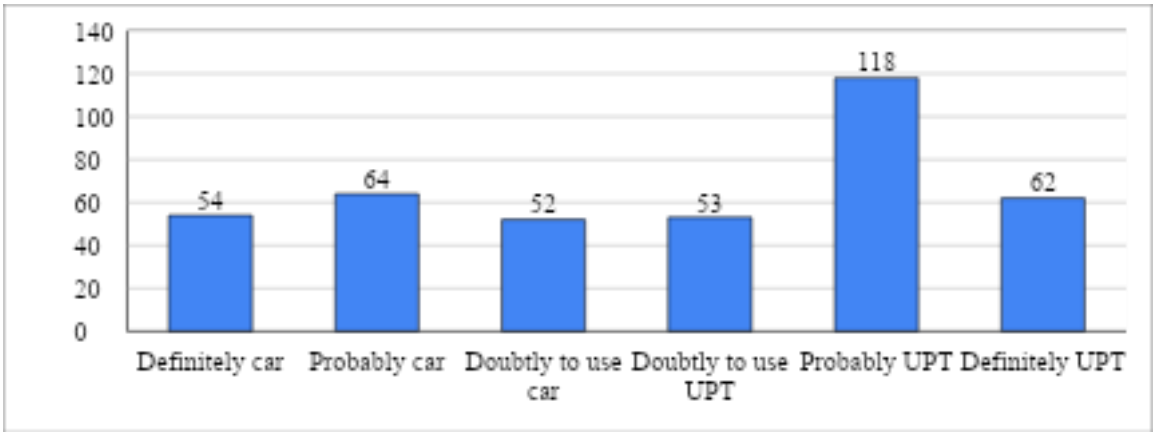

Figure 6. Willingness to reduce car use

When differentiated by gender, Figure 7 shows that the most answers came from female respondents who answered that they probably use urban public transportation as many as 73, only 45 answers from men who said they would use urban public transportation.

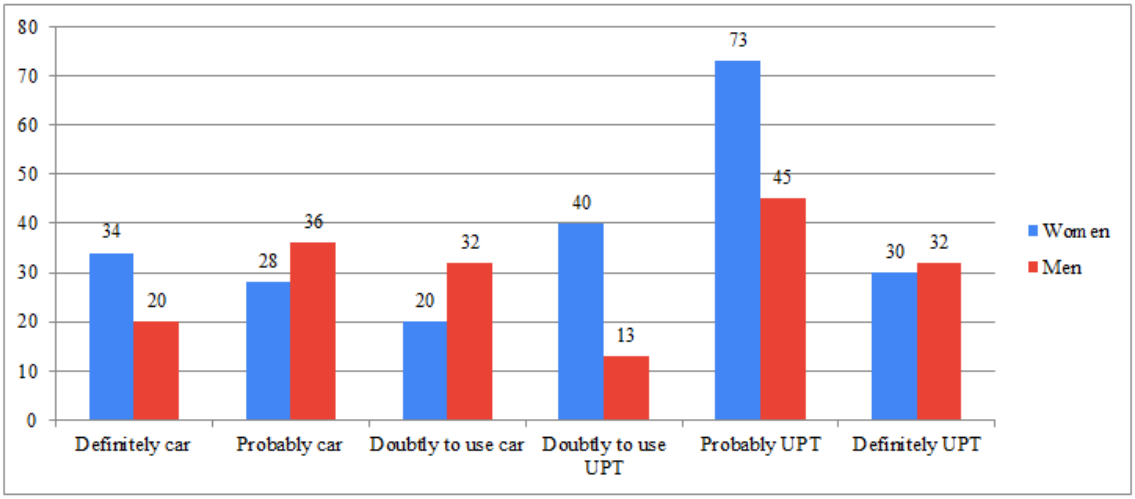

Figure 7. Willingness to reduce car use based on gender

3.5 Partial Correlation Test

The data in this study has been tested for normality using the Kolmogorov-Smirnov Method and it is known that the data is not distributed normally, so the correlation between variables is further tested using the Spearman Method. The Spearman correlation method is commonly used in studies where the data does not meet normal distribution criteria. This non-parametric approach is particularly useful in transportation research, where preferences and habits are often ordinal and not normally distributed. For example, a study on public attitudes toward sustainable transportation used Spearman's correlation to examine how factors like cost influence people's transportation choices. The study found that economic incentives (like cheaper public transport) were more effective in promoting sustainable travel behavior than punitive measures such as increasing fuel prices [12].
Additionally, research on bicycling and network connectivity employed non-parametric methods, including Spearman's correlation, to assess how different levels of traffic stress affect bicyclists' route choices. The study revealed that reducing high-stress segments in urban areas significantly improved connectivity, making cycling a more viable transportation mode [12].
The hypothesis tested in this study was:

- H0 = Variable Y (gender) does not affect variable X (ecological norm/habit of using a car/willingness to reduce the use of a car)
- Ha = Variable Y (gender) affects variable X (ecological norm/habit of using a car/willingness to reduce car use)

The decision maker was: Ha is accepted if the significance value is less than the probability of 0.05.

Table 3: Recapitulation of Spearman Correlation test results

Variable	Correlation Coefficient	Sig. (2-tailed)	Information
Ecological norm	-0.42	0.059	No influence
Car usage habit	-0.09	0.676	No influence
Preference or willingness to reduce car usage	-0.21	0.351	No influence

Source: SPSS output

3.6 Discussion

The selection of transportation modes is an important aspect of travel behavior research, as it influences planning and policymaking. Understanding how women and men differ in determining their modes of transportation can help produce efficient transportation systems, although not many researchers have paid attention to gender differences in the selection of modes of transportation.
Previous research revealed that women prioritize safety, comfort, and flexibility even though it takes longer, while men prefer to pay more to arrive at their destination faster [10]. From this study, it is also known that women are more supportive of and use public transportation, cycling, and walking, this is motivated by maintaining environmental and health considerations. A study at a university in Bandung revealed that women are more pro-environmental and are also influenced by social norms in supporting sustainable transportation. However, in this study, with respondents domiciled in the cities of Jakarta, Bogor, Depok, Tangerang, and Bekasi in Indonesia, the average attachment to ecological norms was at point 4, but it was proven that gender did not influence attachment to these ecological norms [9].

Regarding attachment to the habit of using a car, 55% of the answers to using a car came from women, and 45% of the answers to using a car came from men. This 55:45 ratio can be considered quite balanced for the two genders, this is further proven by a correlation test that states that there is no gender influence on attachment to using a car. This can happen considering that Jakarta is the capital city, one of the metropolitan cities in Indonesia, which allows changes in women's characteristics to become more independent, so that gender differences in mobility are increasingly biased, while Bogor, Depok, Tangerang and Bekasi are Jakarta's buffer cities (satellite cities). Furthermore, regarding the willingness to reduce the use of cars, although Figure 7 shows that I may use public transportation as many as 73 respondents, while only 45 men answered so, the correlation test proves that gender does not affect this willingness/preference.

In the end, this study shows that ecological norms such as the encouragement to use urban public transport for environmental reasons are difficult to attract women to move to urban public transport, in accordance with the previous research that was the reference of this study, which was carried out in Germany (2002). Women are less likely to choose public transit than men; women are more likely to choose to rideshare; and women are less time-sensitive regarding commuting than men are [10]. So, it is better to change urban public transportation to be more attractive for women by accommodating women's needs, revealed three aspects that are very significant in influencing the selection of public transportation for work: safety, comfort, and hygiene factors [9]. Improved safety, comfort, and hygiene factors following the standards of urban women's expectations will further increase the use of urban transportation among women, rather than trying to move women to urban public transportation for ecological reasons [9]. While Indriany et al (2019) found provided a more nuanced understanding of

transportation behavior under risk conditions, demonstrating that individuals are more sensitive to losses than gains in travel time [11].

In the study "Car-free Life and Factors Influencing Travel Mode", improving infrastructure and providing a positive experience with alternative modes (public transportation) can encourage more people to stop using cars [10]. These findings suggest that interventions should focus on the benefits of alternative modes of travel and the importance of habit change.

IV. CONCLUSIONS AND SUGGESTIONS

While women's choice of mode does not correlate with ecological norms and car usage habits, the commitment to reduce car use is also not correlated with gender. Based on this conclusion, the suggestions that can be given are increasing positive experiences for women when using public transportation, and the advantages of public transportation to lean towards aspects that affect women's decisions (feminine norms/values): safety, comfort, hygiene, accessibility factors.

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Appendix I: Questionnaire

Section 1. Respondent Profile

Category	Options
Gender	- Female
	- Male
Age	- 17-25 years
	- 26-35 years
	- 36-45 years
	- 46-55 years
	- 56-65 years
Place of Residence	- Jakarta
	- Bogor
	- Depok
	- Tangerang
	- Bekasi
Occupation	Housewife
	Civil Servant/Military/Police

	Private Employee
	Entrepreneur/Business Owner
	Student
Monthly Income	Less than 1 million IDR
	1 million - 4 million IDR
	4 million - 8 million IDR
	8 million - 12 million IDR
	More than 12 million IDR

Section 2. Ecological Norm
We kindly ask you to respond to each statement below as follows:
'Describes me very well' = 5
'Describes me' = 4
'Neutral' = 3
'Does not describe me' = 2
'Does not describe me at all' = 1
Statement:

1. I feel responsible for using my car as little as possible during leisure time for environmental reasons.

2. I feel responsible for supporting initiatives/ideas/policies that show commitment to environmentally friendly transportation.

3. I feel obligated to use a bicycle or public transportation for environmental reasons.

4. I feel responsible for not disturbing the quality of life in my residential environment by reducing car usage.
5. I feel responsible for preserving the environment; one way to implement this is by choosing the most environmentally friendly mode of transportation available that day.

Section 3. Habit. Now, let's continue with some activities you might often do on your own. Assume that you want to engage in one of the following actions; which mode of transportation would you choose (private car or urban public transport)? Please provide your answer spontaneously without overthinking it.

Visiting friends
Hanging out at a café/restaurant on a day off
Travelling
Shopping for daily necessities
Strolling around the neighborhood

Section 4. Mode Preference.
Assume that a private car is available to you. Imagine you are planning to go to the city center tomorrow. How confident are you that you will use a car or public transportation? You can choose one of six options to evaluate your decision:

1. I will definitely use a private car
2. I will probably use a private car
3. I want to use a private car but am still hesitant

4. I want to use public transportation but am still hesitant
5. I will probably use public transportation
6. I will definitely use public transportation