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Qualitative analysis of the Rotterdam rental bike market

1. Introduction

There are 22.9 million bicycles in the Netherlands, more than any other country in the world. This is around 1.3 bikes per person. Biking is the more sustainable way to get around compared to cars or public transport. A bike accounts for 21 g of CO_2 per kilometre which is more than ten times less than a car. In our research, we want to investigate which type of ride-sharing bike people prefer so that the best possible bike is produced and will entice even more people to use them.

It is important to note that we are focused on ride-sharing bike companies and not any simple rental company. For example, Swapfiets could be confused, however it is only a company where you can rent a bike for a certain period of time with a monthly cost. Ridesharing is a service that arranges one way transportation on short notice (GCS Global, 2022). Currently there are many ride sharing companies such as Check, Felyx, Lime, Vaimoo, Donkey republic… However we are solely focused on bicycles. Lime for example is a ride sharing company that only offers E-bikes (electric bikes). Instead, Donkey Republic only offers bicycles with a specific drop-off location. In our research we add all these attributes together to understand what would make the best sustainable bike. The five attributes we have decided to test are: company values, price, drop off area, bike type and gear.

It’s no secret that biking is better for the environment and during these recent times countries need to adopt the Dutch lifestyle to move around the city more sustainably. However, it is not that simple. It’s hard for people to change their traveling habits from one day to the next. The idea has to seem enticing, efficient and convenient. “For decades, the bike rental system has provided some solutions for the problem of providing bikes to the bike-less. But it’s with the rise of bike sharing systems in major cities that we’ve seen real progress towards improved public transit and reduced car congestion” (Spinlister, 2019). Rental bikes are used more recreationally and bike shares are used for more practical purposes. The bike shares are available whenever

you need to move from one place to the next. When you are in a rush to get to work a ride share is a perfect solution. Instead rental bikes are more often used on holidays or for planned trips around the city for a couple of hours. Ride shares molds the consumer into becoming a more sustainable person.

Globally the bike sharing market was valued at 3.43 billion dollars in 2019 (Jadhav, Jawarkar & Mutreja, 2021), with a projection of 6.98 billion by 2027. The rise in this market could be attributed to technological advancements in this field as well as increased government initiatives and spending on bike sharing infrastructure such as bicycle roads and drop of bike areas. The market is segmented into bike types, sharing system and region. Bike types are divided into electric and traditional, sharing systems describing whether the bike is docked or not. For our research we will use the attribute bike type and the region will be the Netherlands. We will not be focusing on the docking as that is uncommon in the Netherlands.

Research done by Soltani, Allan & Pojani et al (2021) state that the 'typical bike sharer' is male, white, less wealthy, younger than average, works and lives close to the inner city. This is due to women being typically more risk averse. However, in countries where biking is more predominant the results are flipped and women are more likely to use bike sharing than men. Furthermore, parents are less likely to use bike sharing as they prefer to travel with their kids in the car and those who are more technologically inclined are more likely to bike share. Younger people are meant to be more sustainably inclined and will have more of an incentive to need a bicycle as they most likely won't be able to afford a car.

The structure of our research will be organized in the following way. We begin with a description *detailing the new product and its service attributes*. This will include a description of five key attributes and their variation. The *methodology* of our research will then be explained to describe the experimental design of the discrete choice experiment. There will be an explanation on how the data will be further analyzed. The fourth section consists of the *results* describing the analysis done using JMP. Finally, a conclusion will be drawn to answer the research question with limitations and recommendations.

2. Detailing the new product innovation attributes

Due to the bikes' growing popularity in the Netherlands, people can now rent bikes for a fee, in addition to purchasing them. Customers can access what the business offers by using an app to rent a bike. This led to the creation of a quicker and simpler way to rent a bike. Customers may just open the app and look for the bike without having to find a bike rental store.

Even if the popularity of renting bikes is growing quickly, there are a lot of competitors in the bike rental market, which makes it more challenging for a new business to stand out from rivals. There are numerous businesses that offer bike services, such as donkey republic, Swapfiets, and ride Noord. To make matters more challenging, each business has its own distinctive characteristics, such as its costs or the kind of bike it rents. Therefore, this research is conducted to identify the product that people find most attractive. Moreover, we evaluate the service characteristics and come up with the following five key attributes: company values, price, drop-off area, bike type, and gear.

2.1. Company values

The company values are one of the things to consider while analyzing client preferences. The company's values demonstrate whether its supply chain is ecologically sustainable. In contrast to non-eco-friendly values, if a company has an eco-friendly value, it signifies that the organization uses sustainable methods across the supply chain. Examples of this include whether they use recycling practices for their bike, such as using non-renewable batteries on their e-bikes that are thrown out after use and are bad for ecosystems. Another example is whether or not they choose more environmentally friendly options for transporting the raw materials from the supplier to the manufacturer.

2.2. Price

We examine the cost of renting a bike in the present market across The Netherlands, and based on our research and survey, we have determined the following attribute levels for the attribute charged price: €0.3, €0.5, and €0.75. This pricing is the cost per minute that the customer will be charged.

2.3. Drop-off area

The other factor that may influence consumer choice is the drop-off area. The return area indicates which places the bikes can be dropped off after usage. There are three options: first, is ‘City Center Only’ which indicates that the bike can only be returned in the area surrounding Rotterdam Central. Secondly, ‘Drop off areas+City Center’ indicate that there are areas around the city where the bike can be returned, including the city center. Lastly, ‘park anywhere’ indicates that the bike can be left anywhere after usage.

2.4. Bike type

One of the key variables in consumer preferences is the type of bike. There are two types of bikes: electric and pedal-powered. Although a pedal-powered bike is more environmentally friendly, it can also take longer to get to the destination and require more energy from the user. Whereas an electric bike uses less energy and is faster, it is not environmentally friendly. This element led us to develop two different types of bikes for our attribute.

2.5. Gear

The last attribute that is considered is the gear, whether consumers prefer bikes with single or multiple gears. With a single gear bike, it is more low maintenance, lighter weight, but it might be hard to climb up a hill while a multiple gear bike is easier to use up hill and has more possibility to go faster (Basset, 2021).

3. Methodology

A discrete choice model is employed in this study to provide an answer to the research topic. The discrete choice model depends on the random utility model, according to which preferences for various product attributes rather than preferences for the items themselves drive consumer choice. According to this model, respondents will always be offered the option to select from a variety of choices, just as they would in real life. As a result, many market choice circumstances become more realistically depicted (Fader, & Hardie, 1996).

Five key attributes have been chosen for ride sharing bikes. A fractional factorial experiment design was employed in this study to analyze the preferences of the features for the prototype design of students and young professionals without any emphasis on gender. A complete factorial design was also an option, although there were 2x3x3x2x2 = 72 possible choice sets to choose from. This quantity is quite large and may have negative effects on the study. There was a possibility that respondents might stop responding to the questions in the middle of the survey if there were 72 different choice sets. There can also be symptoms of the so-called fatigue effects.

For an effective choice design, it is necessary to consider a variety of factors, including level balance, orthogonality, minimal level overlap, and utility balance, according to Huber and Zwerina (1996). Ten distinct option sets, each with five choices, were used in this investigation. The consequences of weariness were considered while deciding how many choice sets to provide.These were then broken down into different choice sets using the ‘JMP’ software where each respondent was shown a total of 10 choice sets to choose from: each set containing two different options. JMP is a statistical software in which users are able to analyze and create experimental designs according to their needs. Respondents were given an option between two choice sets for each question. This allowed the respondents to carefully consider their choice. Remarkably, there was no way to opt out. Although in reality this is always conceivable, it was crucial to rule out as few options as possible. As a result, as the questions were developing, this choice was left out. Additionally, in order to reduce data manipulation and analytic biases, the

order in which each option set was shown to respondents was randomized. This ensures that each respondent has seen a different order of choice sets.

A survey has been constructed in Qualtrics to produce the data. The poll included an introduction and an explanation of each choice set's components for using the shared e-bike. As a consequence, the respondents were made aware of the details of each piece and their options. This eliminates a variety of prejudices. The responders might then indicate which of the several features for each question they preferred. After that, the respondents were required to react to a series of personal questions on their gender, age, income, place of residence, ownership of a bicycle, and opinion on the importance of a company's environmental practices. To get a clearer view of the responders, this was done. By making a survey, it was possible to investigate which choice the different respondents made. This made it possible to analyze which choice of attributes is taken into account when using a sharing e-bike. The target group for this research were students and young professionals without any emphasis on gender. As a result, the survey was shared on various social media platforms, such as facebook, WhatsApp and linkedin. Due to the research by Soltani, Allan & Pojani et al (2021), this specific target group has been taken into account. The respondents to this study were representative of the study's target audience. Regarding external validity, this was crucial.

The Qualtrics data was exported to Excel after there were 120 responses. After that, it was possible to use JMP to analyze the responses. The survey responses were used in likelihood ratio tests, effect marginals and utility profilers, as well as theoretical market simulations in order to gain an understanding of the attributes that significantly impact consumer choice, which attributes have the largest impact on consumer choice, and the combination of attributes that will maximise market share.

4. Results

We tackle the results in a six-stage approach. First, in Subsection 4.1, we determine which attributes out of the five included in our study are statistically significant in increasing the chances that potential users prefer a given bike. Then, Subsection 4.2 analyses the marginal

effects that different attribute levels have on the utility derived by the user. Subsection 4.3 shows our target audience. Then, Subsection 4.4 offers the ideal bike given our obtained target customer. Subsection 4.5 gives a simulation of how that market would react to the introduction of our product. Lastly, Subsection 4.6 offers our recommendation based on the previous subsections.

4.1. Likelihood ratio test

The first step in our analysis is performing the likelihood ratio test to determine whether a given attribute is statistically significant in predicting the choice of a customer.

Based on the test present in Figure 1, it turns out that 4 of the 5 attributes, namely the company values, price, drop off area, and bike type are all statistically significant at a 5% level. On the flipside, the gear configuration is statistically insignificant at a p-value of roughly 1. This indicates that the customer's decision of whether to choose a certain bike configuration is virtually unaffected by the fact that the bike has single or multiple gears. This is a useful finding for a bike-sharing company, since it indicates they are able to save on manufacturing and maintenance costs on their bikes by only choosing to use single speed bikes, without losing out on potential customers.

Likelihood Ratio Tests

Source	L-R ChiSquare	DF	Prob>ChiSq
Company values	19,365	1	<,0001*
Price	37,655	2	<,0001*
DropOff Area	63,179	3	<,0001*
Bike Type	9,642	1	0,0019*
Gear	0,000	1	1,0000
gender*Company values	3,514	1	0,0608
gender*Price	1,658	2	0,4365
gender*DropOff Area	0,000	3	1,0000
gender*Bike Type	1,095	1	0,2954
gender*Gear	0,185	1	0,6670
age*Company values	0,000	3	1,0000
age*Price	16,118	6	0,0131*
age*DropOff Area	10,568	9	0,3065
age*Bike Type	12,563	3	0,0057*
age*Gear	0,765	3	0,8578
yearly income*Company values	1,483	5	0,9150
yearly income*Price	10,935	10	0,3626
yearly income*DropOff Area	17,127	15	0,3113
yearly income*Bike Type	27,361	5	<,0001*
yearly income*Gear	6,185	5	0,2886
importance of eco friendlyness*Company values	12,499	5	0,0286*
importance of eco friendlyness*Price	8,130	10	0,6161
importance of eco friendlyness*DropOff Area	15,401	15	0,4229
importance of eco friendlyness*Bike Type	14,600	5	0,0122*
importance of eco friendlyness*Gear	4,684	5	0,4557

Effect Marginals

Figure 1: Likelihood ratio test results

Furthermore, analysing the interactions between the 5 attributes used to describe the bikes and the customer demographic characteristics, we have more findings. As one would expect, yearly

income and bike type are significant, perhaps it is because high income individuals value using a more comfortable, electric bike. Then, age has significant interactions with the attributes price and bike type, suggesting that younger people may be more price sensitive than older people and may be more interested in the bike type that they use. The importance of eco friendliness also has notable interactions with company values and bike type. This may be due to the fact that a person that values the environment highly would also be more strongly influenced towards a bike profile which is produced by a ecologically friendly company.

4.2 Effect marginals

Subsection 4.1 gives us a rough idea of the attributes which are interesting to further analyse. Now it is time to quantify exactly how important each attribute and its respective attribute level is for the final consumer.

Figure 2 shows that regarding company values, people derive a utility of 0.38 for an eco friendly brand and -0.38 for a non eco friendly brand, creating a pretty large 0.76 range between the levels. Looking at price, people have a strong positive preference for the 0.3 euros per minute level and a strong negative preference for the 0.75 euros per minute level. 0.5 euros per minute is still somewhat satisfactory to customers (marginal utility of 0.07), but not by a large margin. Regarding drop off areas we notice that people value a park anywhere policy while they strongly dislike a city centre only drop off. Then, bike type and gear type do not seem very influential.

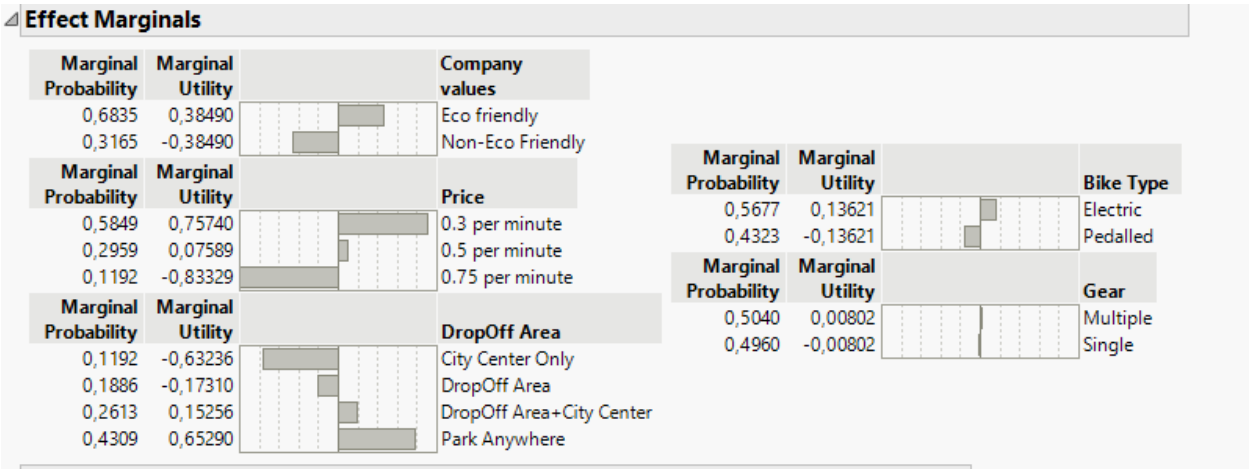

Figure 2: Effect marginals of attributes and attribute levels

Table 1 and Figure 3 use the ranges created between the attribute levels with the highest and the lowest utility to derive the overall importance of each attribute that we looked at. It turns out that the price is the most important attribute, which makes sense considering that most of our applicants are young and have an yearly income lower than €10.000, making them especially price sensitive. Then, with a value of 0.32, the drop off area is the second most important

attribute, being still noticeably more important than the third most important attribute, company values (with a value of 0.19). Although statistically significant, the bike type is not important relative to other attributes, having a value of only 0.07. Lastly, as expected, the statistically non-significant gear type is also the least important attribute to our respondents, with an importance coefficient of 0.004.

	Range	Importance
Company values	0.7698	0.1956682536
Price	1.59069	0.4043225959
DropOff Area	1.28526	0.3266882042
Bike type	0.27242	0.06924388886
Gear	0.01604	0.004077057402

Table 1: Attributes importance

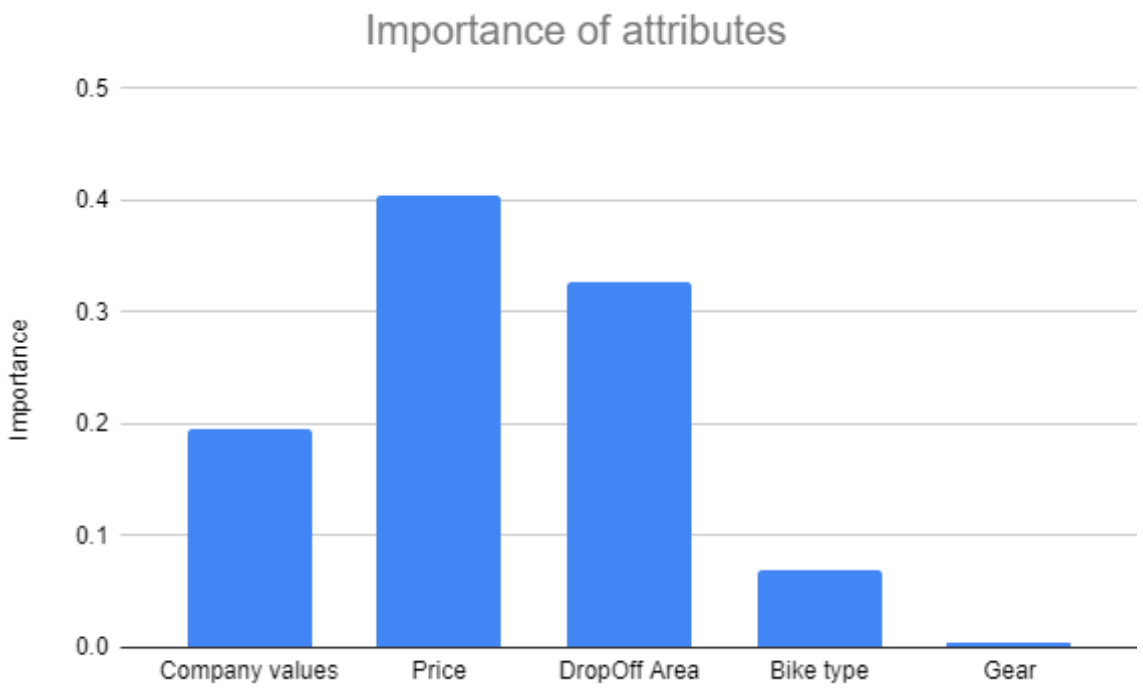

Figure 3: Attributes importance visualised

4.3. Target audience

The attribute combination which maximises the desirability of our bike sharing business depends on gender, age, yearly income, place where respondent lives, whether they own a bike and how important they find that a business they use is ecologically friendly.

Rotterdam is a city that accommodates mostly young people due to its many higher education facilities, whilst simultaneously having an old population (60+) who accounts for over 50% of the car ownership in the city. People between the age of 17 and 24 tend to be the most common bike renters. Young people tend to be in the lowest yearly income brackets due to having part time jobs whilst completing their education. Furthermore, Rotterdam is a very environmentally conscious city, and thus we expect that the average young person in Rotterdam should highly value eco-friendliness.

As a result, our target audience for the new rental bike service would be aged 17 to 24 years old with a yearly income of less than €10.000 that highly values eco-friendliness. We notice that gender does not have interaction effects with other customer or bike attributes and thus does not need to be specified.

4.4. Utility profiler

Based on the specified customer profile, we run the utility profiler in JMP to find the optimal attribute combination, as seen in Figure 4.

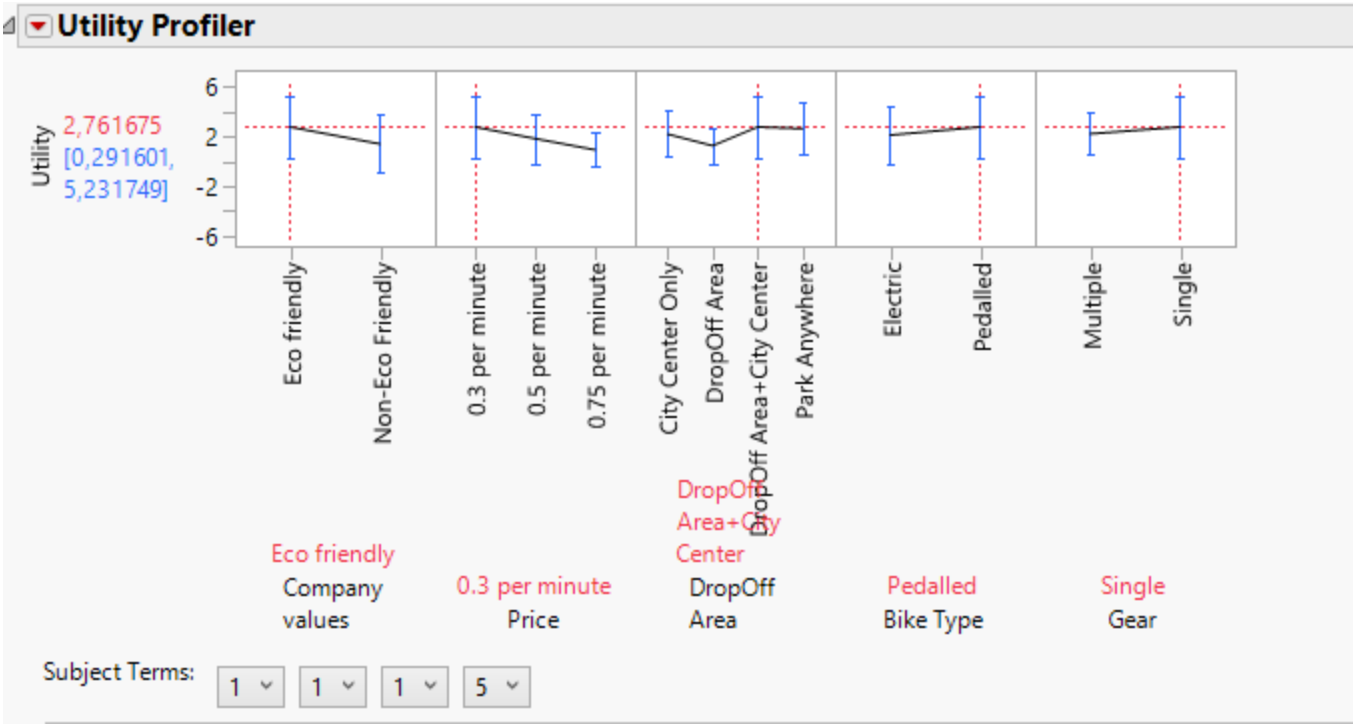

Figure 4: Utility profiler results

As a result the ideal rental bike service for our demographic would be a pedalled bike from an eco-friendly company with a single gear that can be dropped off in a drop off area and the city centre and costs 0.3 euros per minute to use.

It should be noted that the interaction effect between the importance of eco-friendliness and bike type is undermined due to being weaker than the interaction effect between yearly income and bike type.

4.5. Market simulation

Using the optimal bike sharing service profile that was generated, we want to visualise the impact that would be brought to the market by bringing in such a service.

Table 2 shows the market share of 3 different companies (Ridenoord, Donkey Republic, and Swapfiets) before the introduction of the new bike rental service, while Table 3 shows how the market share has shifted to the new bike rental service after its introduction. Note that all attribute levels are hypothetical, purely chosen to represent 3 diverse choice sets which may be available on the market that do not dominate and are not dominated by our proposed new rental bike service.

	Company values	Price	DropOff Area	Bike type	Gear	Utility	Market share
Ridenoord	Eco friendly	0.5 per minute	DropOff Area+City Center	Pedalled	Multiple	1,27496671	34,35%
Donkey Republic	Eco friendly	0.75 per minute	Park Anywhere	Pedalled	Single	0,7878135344	21,10%
Swapfiets	Eco friendly	0.3 per minute	City Center Only	Electric	Single	1,534924622	44,55%

Table 2: Market share before new rental bike service

	Company values	Price	DropOff Area	Bike type	Gear	Utility	Market share
Ridenoord	Eco friendly	0.5 per minute	DropOff Area+City Center	Pedalled	Multiple	1,27496671	13,64%
Donkey Republic	Eco friendly	0.75 per minute	Park Anywhere	Pedalled	Single	0,7878135344	8,38%
Swapfiets	Eco friendly	0.3 per minute	City Center Only	Electric	Single	1,534924622	17,68%
New rental bike service	Eco friendly	0.3 per minute	DropOff Area+City Center	Pedalled	Single	2,761675357	60,30%

Table 3: Market share after new rental bike service

Figure 5 is a visualisation of Table 2 and Table 3. Based on the profile of the three previous companies, a lot of their market share of customers which are young, low in income, and value ecological friendliness will be shifted towards the new bike rental service. In fact, based on this simulation, the new bike rental service will own a majority of the market share of the mentioned customer demographic.

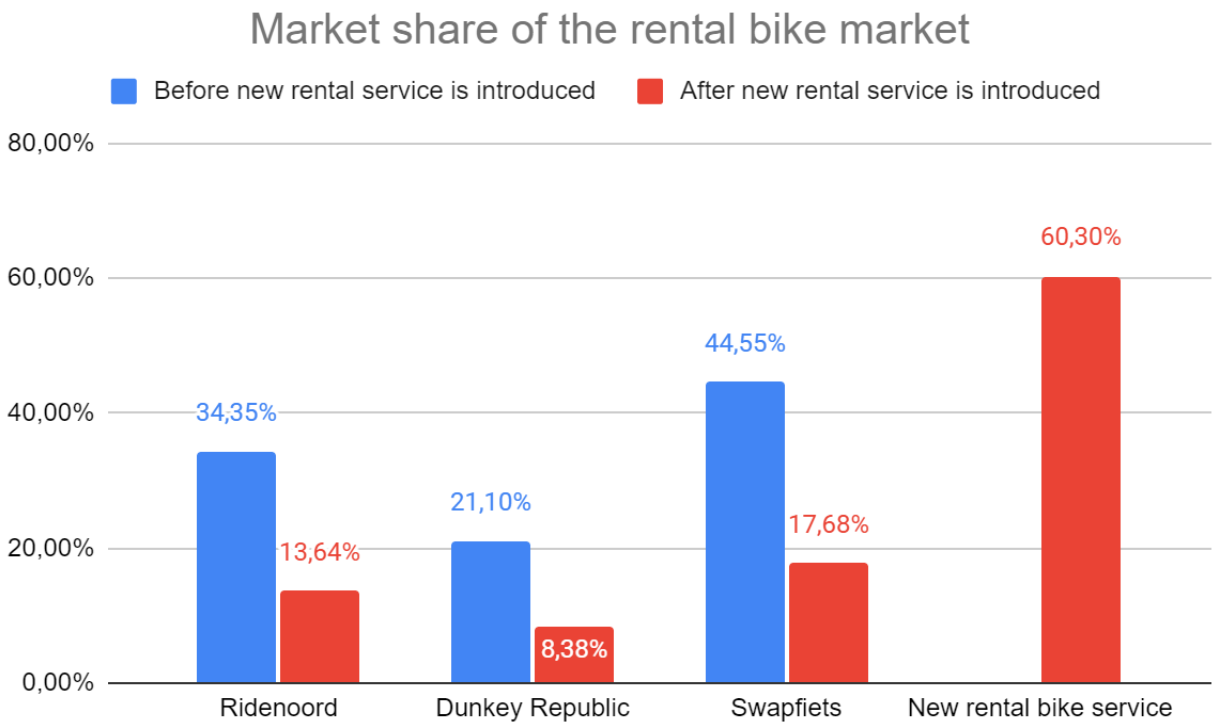

Figure 5: Impact of the introduction of new bike rental service

4.6. Recommendation

Based on the market simulation, we would recommend a bike rental service that is cheap, comes from an eco-friendly company, allows for parking in a drop-off area + the city centre while being pedalled for a customer demographic of young people with low incomes that are highly environmentally conscious.

As we find that the gear type has no significant effect, the service company should choose the option that is the cheapest to produce in order to keep the service affordable to consumers, leaning towards a single rather than multiple speed bike.

Furthermore, a bike being electric does not seem to have a large importance in influencing a young person's decision of which bike rental service to pick, which is why the company can take advantage of this fact by only creating pedalled bike, allowing them to further improve upon the attribute which is most important to this customer demographic - price.

5. Conclusion and Recommendations

5.1. Conclusion

The research report was designed with the intent to understand the attributes that a consumer is interested in when choosing to rent a bike and produce a theoretical combination of attributes that will entice the most people to utilize them.

Through conducting likelihood ratio tests, the research showed that people are interested in the price, the available drop-off areas, bike type, and the company values of the company regarding the environment, whilst not having any interest in other aspects of the bike such as the gears.

Furthermore, the likelihood ratio tests supported the existence of a variety of positive interaction effects between consumer characteristics and bike attributes, which showed the existence of a positive correlation between age and ideal price and bike type, the effect of yearly income on ideal bike type choice, and finally, the respondent's valuing of the environment on both company values and bike type. The research also supported the lack of correlation between attribute choices and gender.

The conducted marginal tests showed that the attribute that has the most effect on impacting consumer choice is price, whilst gear type has little to no effect.

Target audience research allowed the team to reach the conclusion that in a city such as Rotterdam which is mainly made up of young, low-income students completing their studies, as well as wealthy older civilians who own over 50% of the cars in the area and thus have no interest in rental bike services, the target audience of the rental bike market are young, low-income customers who highly value the environment.

In conclusion, taking into account the statistically significant attributes, the interaction effects, the effect marginals and the target audience, the ideal attribute combination that will maximise the amount of consumers for a rental bike service in Rotterdam would be rental pedalled bikes provided by an eco-friendly company for the lowest possible price and that can be dropped off in designated drop-off areas as well as the Rotterdam city center.

5.2. Further recommendations

The results of our research imply that if a company is attempting to enter the Rotterdam rental bike market, their top priority would be to attempt to cut costs and pass those savings onto consumers, as the marginal tests showed that technical aspects of the bike that would have a high impact on the quality, such as the number of gears and bike typing, have much less impact on swaying consumer choice compared to the pricing of the service. From a practical

perspective, any company attempting to lower their bike quality in order to cut costs should be careful when doing so as associating any young company with low quality could be detrimental to the company's public image and sales. (Berk Ataman et al.,2003)

In order for our results to be accurate, the analysis was limited to four consumer attributes. If further research was to be conducted, it is strongly suggested to analyse further consumer characteristics and how they may impact the idealistic bike's attributes, such as parental income, distance from the Rotterdam city center, and average distance of daily commute. Deeper analysis into the target market would allow the conclusions reached to better reflect the ideal consumer and thus the ideal rental bike.

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