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Intergroup Comparison of Personalities in the Preferred Pricing of Public Transport in Rush Hours: Data Revisited

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Abstract: Public authorities and administrations in the developed world are trying to reduce air pollution through the introduction and promotion of public transport. Typically, passengers are charged flat fares. However, with passenger numbers rising, this flat rate pricing model ceases to be sustainable, and a new trend arises—to charge more during traffic peaks as an incentive to even the load and travel outside of rush hours. However, it can be also argued that prices should be lower during rush hours due to poorer service quality—public transportation tends to be crowded and slow. Our on-line questionnaire did not discuss the logic of pricing models, having only measured the preferences of Czech university students (N = 256). The objective was to investigate whether there is a difference in demographic factors or in personality traits between respondents preferring a lower, flat, or higher pricing model. One-way analysis of variance was used for the intergroup comparison. The majority of respondents prefer flat pricing; higher pricing was the least preferred of the three considered models. The main findings were that men, narcissists and people who tend to find fault with others (i.e. lower in one facet of agreeableness) were in favor of higher prices during rush hours. In particular, the latter finding may be useful for policy makers, as it suggests that there ought to be no or only a little tension after higher rush hours prices are introduced.

Keywords: public transport; pricing; personality traits; gender; preference

1. Introduction

There are several new trends and developments in public transport in Europe, e.g., free public transport in Luxembourg, heavily discounted fares in Prague, and the re-introduction of tram lines and the mass introduction of electric buses in Denmark. Policymakers are attempting to move people from individual to public transportation in general, from diesel buses to public transportation powered by electricity, or even directly to bicycles. Our paper looks into the pricing aspects of public transport.

It has already been established that various factors (including issues such as socio-economic status or the passenger's political opinion) may determine the preference for pricing in the public transport segment. Our paper takes into consideration personality traits, demographic factors, and perceptions of what would be right and what would be unfair. However, the concept of what is right and wrong is complicated because it can rely on a wide range of different definitions and issues, such as morality, inspiration and money-spending habits. The Big Five has already been used to look into the effects of these aspects. Song and Shi [1] examined correlations between empathy and personality traits – suggesting that the Big Five personality traits would influence self-reported mental and affective empathy assessments.

Regarding the negative aspects of motivation, Zeigler-Hill and Hobbs [2] examined pathological personality traits and basic social motives. Basic personality characteristics (such as agreeability) revealed a direct relationship to different social motivations (self-protection, illness prevention and desire for status).

The impetus for ticket pricing moves from the original cost approach to a demand based approach, as Shapiro et al. [3] discovered after analyzing the effect of perception of familiarity, fairness and intentions in ticket purchasing decisions. The decision to buy could, therefore, be affected by a passenger's perception that demand-based fare rates are rational, which could have a positive impact on the passenger's purchase behavior. Perceptions of fairness and purchase intentions depend on conditions specific to a transaction, such as the ticket source, reference price and familiarity. Public transportation is not the only area where dynamic pricing is possible. Drea and Nahlik [4] found similar results in major baseball league.

Economic analysis must take into account market elasticity. Tsai and Mulley [5] addressed this problem by applying a pseudo-panel approach to determine both short and long-term public transport demand elasticities in Sydney. They brought multiple determinants of demand into their model; for instance, the socioeconomic characteristics of passengers, public transport prices, land use characteristics and the level of public transport.

De Grange et al. [6] studied price elasticities of demand for public transport and concluded that changes in fares are the main factor in the evaluation of the impact on passenger flows.

Fair public transportation ticket pricing may also be regarded as a game with constrained cost allocation, as public transportation ticket pricing generally focuses on welfare optimization. It is not equitable, however, in that users of the common/shared infrastructure are expected to fund the costs that they incur. Borndörfer and Hoang [7] suggested that the way to establish fair ticket prices is to combine concepts from both linear and integer programming and cooperative game theory. A significant improvement in perceived fairness may be achieved when the problem is approached as a generalization of cost allocation game. An allocation game can account for constraints on output prices and on the coalition formation.

According to Puwein [8], a major factor in setting prices for transport services is not fairness but transport policy. It is usually the government which approves the tariffs, raises the cost of transportation services by imposing taxes and setting up public charges, regulates competition, controls investments in infrastructure, and subsidizes transport services. For example, accessibility was the main policy driver in Bogota [9]. Transport technology advances only have a long-term effect on prices. Tariffs for public transportation, which are predominantly based on government policy considerations, were almost untouched by the cost increases in the private transport market. Cervero [10] concluded that every studied bus system within the United States charged its customers flat rates, even though the distance travelled and the peak hours were, on average, higher, which resulted in an increase in the cost of transport in general. Long-distance, peak-hours passengers have, therefore, been cross-subsidized by short-distance, off-peak passengers. Actually, the majority of published studies on transit fare models conclude that the practice of flat fares is unfair – they charge more to short-distance and off-peak users. According to Cervero [11], passengers are about twice as likely to prolong travel time rather than pay an increased fare. This presents a commercial argument to strive for higher quality transit services at higher prices. There is one more interesting result from cross-elasticity research. It appears that higher car and gas prices have a greater impact on public transport ridership than low price tickets.

Governments across the developed world are proposing various peak and off-peak pricing strategies to even travel demand. Lovric et al. [12] used an activity-based demand perspective to compare two off-peak pricing models in Singapore. The first was free travel just before peak time on the mass rapid transit (MRT); the second was just a discount for the off-peak integrated transit (MRT and public buses). The analysis found positive results for the second of those strategies—off-peak discount pricing—identifying it as a viable policy option for spreading demand peaks, and as more effective in spreading the load during the afternoon peak period. Lan et al. [13] reached the same conclusion by

analyzing different tariffs in Taipei Metro system—an implementation of time-dependent tariffs shifted some peak-hour Metro travelers to off-peak periods. The same behavior was also observed in Paris, France, as described by Kilani et al. [14].

Public transport pricing policy is also very closely connected with the issue of fare evasion (free riding). When ticket prices are set too high, or considered unjustified, fare evasion can reach up to one third of passages (a 10% increase in the fare raises evasion by two percentage points), resulting in significant economic losses for the transit system [15–17]. Free riding, therefore, severely restricts possibilities for increasing the price of tickets. Burguillo et al. [18] considered the link between fare evasion and price elasticity with regard to the impact on welfare generated by the increase of Madrid public transport prices in 2008–2012. They confirmed that public transport price elasticities are around just 0.1%, are only significant for the years of the highest price increase, and that increased prices have harmed low- and medium-income households with a similar impact.

De Borger and Proost [19] analyzed the political economy of public transport quality and pricing with respect to two types of travelers—those without cars who rely only on public transport and those who have their own vehicles but also demand public transport for commuting. They established that the decentralization of decision-making results in higher fares and better recovery of costs incurred—which goes well with the prevailing huge subsidies for public transport in Europe, and is also consistent with the tendency to decentralize policy-making in this sector. To estimate optimal bus fares, Kaddoura et al. [20] adopted an agent-based model and applied to it the rules of marginal cost-pricing. They reexamined the relationship between travel distance and optimal fare pricing while taking into account external effects, such as the delays caused by the transport system (including capacity issues) and passenger-induced problems. They opposed the idea of flat fares, and declared that bus fares calculated on the basis of trip length were optimal. The optimal pricing for urban transport was later studied by Proost and van Dender [21] through a numerical model of transportation, with the help of data from two urban centers—London and Brussels. The researchers calculated the optimal price structure for urban transport, and its effects on transport equilibrium and public welfare. The study showed that the optimal transport prices are higher than the prevailing prices in most of the transport markets (of Western Europe). The current demand is above the optimal transport demand. They demonstrated that charging minimal transit fares in the peak hours makes few welfare gains because of people's preference for public transport in those hours. As this literature review has shown, the subject of rush hour and off-peak pricing models is fairly well known and studied. However, we have identified a gap in the literature when it comes to the connection between perceptions of the fairness of these pricing models and personality traits (and demographic factors) of passengers; this is the central focus of this study. More specifically, the aim of this study is to investigate whether there is a difference in demographic factors or in personality traits between respondents preferring lower, flat, or higher pricing strategies.

The remainder of this article is organized in the traditional way: section two explains what data were collected and how, and which tests were performed. Section three presents the results of the analysis. In the last section, we draw some conclusions.

2. Materials and Methods

Youngsters and students have the highest rate of public transport use among the various age groups [22]. The high upfront and running costs of car ownership force students to either save up or wait until they have sufficient income to afford a car. Therefore, the travel behavior of young adults favors public transport. Jorritsma and Berveling [22] have found that young adults use cars less often in Western countries like Germany, England, France, the United States, Australia and Japan. Young people in the Netherlands also travel less by car and are more inclined to travel by bicycle and public transport. As they get older, however, they travel more frequently by car. This is the reason why our research focuses on the student population, which has the highest share of public transport use.

The sample does not suffer from self-selection bias, since all the students filled in the questionnaire under the supervision of their teacher, who ensured full participation (but preserved the anonymity of the answers). The random selection of courses from several universities, faculties and years of study makes the sample to some extent representative of the general student population in the Czech Republic. Data for our article were collected at the end of 2016 and the beginning of 2017 by a web-based survey. There were a total of 264 respondents (117 males and 147 females) with an average age of 20 years, who were university students from various universities in the Czech Republic. With regards to accommodation arrangements, 75 lived in a dorm, 100 lived with their parents, 33 shared an apartment and 48 lived alone or as a couple. Considering the size of their city of origin, 34 came from a village with up to 500 inhabitants, 53 from a city with up to 10,000 inhabitants, 46 from a city with up to 50,000 inhabitants, 40 came from a city that is a regional (NUTS 3) center and 83 came from Prague. The coding is from 1—village, to 5—Prague; the scale roughly resembles a logarithm of the number of inhabitants.

Answers were collected using the online tool SurveyXact. The survey was divided into two parts. The first page contained the Big Five personality traits statements, trust statements and the statement measuring narcissism. The second page measured the self-identity construct and the preferred pricing of public transport in rush hours. Respondents who quit after submitting the first page and respondents with incoherent answers (random high numbers as answers for multiple open-ended questions) were excluded from the analysis. Therefore, the effective sample size was N = 256.

Personality traits were measured using the Big Five Inventory-10 [23], which was confirmed to be of high psychometric quality [24]; a validated Czech translation [25] was used.

The Single Item Narcissism Scale (SINS) [26] was placed right after the Big Five Inventory-10 statements; the validation of the SINS has already been replicated, confirming its high psychometric quality [27].

Trust was measured using the statements adopted from [28]. Originally, these statements were meant as answers, but Miller and Mitamura [29] and Wuthnow [30] found that these statements are not true opposites (and should rather be used as two separate questions). This was also the case in this data set; the Pearson correlation coefficient between trust and mistrust was -0.092 [31].

Additionally, innovativeness, tech savviness and opinion leadership were measured using statements from [32,33], where they were used as a self-identity construct. The instruction was “Please indicate to what degree you agree with the following statements”:

- “I consider myself innovative”;
- “I consider myself tech savvy”;
- “I consider myself an opinion leader”.

All the mentioned variables were measured on a 1–5 Likert scale, where 1 stood for ‘strongly disagree’ and 5 meant ‘strongly agree’.

The preferred pricing of public transport in rush hours was measured using the question "What is your relation towards discounts?", followed by these three possible answers:

- “Travel fares during rush hours should be lower”;
- “Travel fares during rush hours and outside rush hours should be the same”;
- “Travel fares during rush hours should be higher”.

The counts for lower, flat and higher pricing were 77, 150 and 29 respectively. In comparison to the conference paper version [34], which relied on logistics regression, intergroup comparison was used. The journal version contains more variables; these additional variables were correlated with personality traits and gender [31,35–37], and because of this multicollinearity, a bi-variate approach to testing was used in place of a multi-variate approach. The one-way analyses of variance [38] used the preferred pricing as a factor. Personality traits were also analyzed on a facet level; this was not performed in the conference paper version [34] because it did not make sense in the multi-variate

setting. This new approach allowed us to overcome the masking effect (when a facet is significant but the trait as a whole is not significant) and the cancelling effect (when facets of the same trait significantly influence the dependent variable, but in opposite ways, so the trait per se appears not to be significant); the terms were defined in [39]. For variables which were/had been significant in the analysis of variance, the least significant difference post-hoc test [38] was used to identify between which preferred pricing groups the differences were significant. The chi-squared test [40] was used to verify the significance of gender, and to test whether there was any (non-linear) relationship between the size of the city of origin and the preferred pricing. Results were interpreted at the confidence level $\alpha = 0.05$, in accordance with [38], while being aware of the logic of its criticism published over 100 years ago [41]. IBM SPSS 22 was used for the analysis.

3. Results

Intergroup comparisons are provided in Table 1. To avoid the masking and cancelling effects, the individual statements for the Big Five traits are also provided right after the traits.

Table 1. Intergroup comparisons.

	Lower		The same		Higher			
	Mean	**st. d.**	**Mean**	**st. d.**	**Mean**	**st. d.**	**F**	**Sig.**
Extraversion	3.65	0.77	3.51	0.96	3.52	1.02	0.588	0.556
is reserved	3.13	0.88	2.97	1.06	2.97	1.32	0.616	0.541
is outgoing, sociable	3.86	0.90	3.58	1.08	3.52	1.02	2.182	0.115
Agreeableness	3.36	0.86	3.45	0.75	3.31	0.89	0.577	0.562
is generally trusting	3.22	1.06	3.21	1.06	3.31	1.04	0.117	0.889
tends to find fault with others	2.88	1.00	2.77	0.93	3.34	1.14	4.178	0.016
Conscientiousness	3.48	0.84	3.39	0.83	3.52	0.87	0.442	0.643
tends to be lazy	3.44	1.23	3.57	1.19	3.31	1.23	0.678	0.509
does a thorough job	3.97	0.83	3.87	0.90	3.90	0.94	0.379	0.685
Neuroticism	3.53	1.03	3.49	1.09	3.28	1.10	0.626	0.536
is relaxed, handles stress well	2.74	1.11	2.81	1.24	3.03	1.30	0.633	0.532
gets nervous easily	3.38	1.14	3.43	1.13	3.21	1.24	0.455	0.635
Openness to experience	3.82	0.76	3.61	0.93	3.79	0.94	1.670	0.190
has few artistic interests	2.74	1.13	3.03	1.35	2.86	1.48	1.328	0.267
has an active imagination	3.81	0.89	3.80	0.95	4.03	0.98	0.798	0.451
Narcissism	2.08	1.00	2.34	1.16	2.66	1.32	3.006	0.051
Trust (most people can be trusted)	2.55	0.95	2.45	0.90	2.76	1.24	1.349	0.261
Mistrust (you can't be too careful in dealing with people)	3.48	0.88	3.51	0.92	3.62	1.02	0.246	0.782
Innovativeness	3.29	0.74	3.25	0.87	3.55	0.83	1.660	0.192
Tech savviness	3.30	0.89	3.29	0.99	3.28	1.10	0.007	0.993
Opinion leadership	3.13	0.80	3.14	0.96	3.48	0.99	1.842	0.161
Age	20.16	1.61	20.33	1.66	20.41	1.66	0.375	0.688
Gender	1.66	0.48	1.56	0.50	1.28	0.46	6.638	0.002
Size of the city of origin	3.40	1.23	3.29	1.48	3.38	1.35	0.180	0.835

In case the size of the city of origin was treated as a nominal—as opposed to an ordinal—variable, the significance was virtually the same; Chi-square statistics = 4.016, and the *p*-value = 0.856. Similarly, the significance of gender stayed the same; Chi-square statistics = 12.764, and the *p*-value = 0.002.

Post-hoc tests for significant variables from Table 1 are provided in Table 2. The least significant difference test identified between which preferred pricing groups there were significant differences.

Table 2. Post hoc multiple comparisons.

Dependent Variable	(I)	(J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tends to find fault with others	1	2	0.110	0.137	0.423	−0.16	0.38
		3	−0.462 *	0.213	0.031	−0.88	−0.04
	2	1	−0.110	0.137	0.423	−0.38	0.16
		3	−0.571 *	0.198	0.004	−0.96	−0.18
	3	1	0.462 *	0.213	0.031	0.04	0.88
		2	0.571 *	0.198	0.004	0.18	0.96
Narcissism	1	2	−0.262	0.159	0.100	−0.57	0.05
		3	−0.577 *	0.246	0.020	−1.06	−0.09
	2	1	0.262	0.159	0.100	−0.05	0.57
		3	−0.315	0.229	0.171	−0.77	0.14
	3	1	0.577 *	0.246	0.020	0.09	1.06
		2	0.315	0.229	0.171	−0.14	0.77
Gender	1	2	0.102	0.068	0.135	−0.03	0.24
		3	0.386 *	0.106	0.000	0.18	0.60
	2	1	−0.102	0.068	0.135	−0.24	0.03
		3	0.284 *	0.099	0.004	0.09	0.48
	3	1	−0.386 *	0.106	0.000	−0.60	−0.18
		2	−0.284 *	0.099	0.004	−0.48	−0.09

*. The mean difference is significant at the 0.05 level.

There was a significant difference in finding fault with others between, on one hand, respondents who preferred higher pricing in rush hours and, on the other hand, people who preferred flat and lower pricing. The former group scored higher in finding fault with others. The reverse-coded statement is an indicator of altruism. This is a new finding compared to the conference paper version [34]: the agreeableness trait was not significant (p-value = 0.278) in the ordinal logistics regression model; the analysis was performed only on the traits level, not on the facets level. The effect of altruism was masked by the effect of trust within the agreeableness trait.

This is interesting on two levels. Firstly, on the trait level, people who are higher in agreeability tend to be in favor of the status quo. Since, to the best of our knowledge, all university cities in the Czech Republic use flat pricing, we expected agreeability as a whole trait to be linked to flat pricing. Secondly, on the facet level, since pickpockets are a threat in many bigger cities, and they also operate in public transport, we expected mistrustful people to prefer to travel with as few other people as possible—this way, passengers could easily notice if somebody wanted to rob them. The lower number of co-passengers may be achieved by the higher pricing of public transport during rush hours. Even though there were three measures of trust, none of them was linked to pricing.

Narcissism can be considered significant, even though its p-value was 0.051, because it was measured using only one statement—SINS. Common narcissism instruments use 10–148 statements. It is very likely that if narcissism was measured using a larger construct, it (or at least one facet of it) would have a lower p-value. There was a significant difference in narcissism between, on one hand, respondents who prefer higher pricing in rush hours and, on the other hand, people who preferred lower pricing. More narcissistic respondents preferred higher pricing. There was a significant difference in gender between, on one hand, respondents who preferred higher pricing in rush hours and, on the other hand, people who preferred flat and lower pricing. Men preferred higher pricing.

4. Conclusions

The aim of this article was to investigate the relationship between personality traits and the preferred pricing of public transport in rush hours, i.e., how the profiles of respondents preferring lower, flat, or higher pricing differ. Since it is mostly young people who do not have cars and, therefore, rely on public transport, the research was based on a university student sample. This is a limitation of the research; further research could survey the whole population of young people, or the whole

population of people who use public transport on a daily basis. In the latter case, it is possible to expect that age may turn out to be significant.

According to the results, the higher pricing of public transport in rush hours is preferred by respondents who tend to find fault with others, are more narcissistic, and are men. Future research could additionally focus on why men are in favor of higher pricing in rush hours. A possible hypothesis is that women are more egalitarian due to facing a gender wage gap, and that they are egalitarian in multiple domains. Another interesting (non-)finding is that opinion leadership is not significantly linked to any of the pricing models. The managerial implication is that there probably would not be a big backlash if switching from flat pricing to higher pricing in rush hours, since people who tend to find fault with others actually prefer higher prices in rush hours. On the other hand, only one in approximately nine was in favor of the higher pricing model; this implies a 95% confidence interval of 7–16%. In other words, the higher pricing of public transport in rush hours is the least preferred pricing model of the three investigated options. Since the majority of respondents prefer flat prices, it may be an idea to keep the prices flat, and to increase the number of buses, so that they have the capacity needed in the rush hours. Then, using the logic behind Activity-based Costing, a use for extra buses not needed during the rush hours should be found. In the age of ride-hailing applications like Uber, it is possible to offer a possibility to order a bus (by a phone or through an app) from anywhere to anywhere, such as "flextur", offered by Flextrafik in Denmark. This can be used, for example, for taking school children to a museum; wedding guests from the central station to a hotel; or collecting people throughout the city who are going to attend the same funeral, or who are heading to a cemetery because of All Saints' Day, or collecting people who are heading to the same hospital.

It may be expected that there will be fewer passengers during rush hours after the COVID-19 lockdown because some people will work from home more often than before, and some people will end up unemployed, so they will not need to travel. Therefore, the pressure on increasing efficiency and decreasing the number of passengers during rush hours is probably lower now than when the research was conducted.

The survey was conducted in the Czech Republic, but it is possible that the findings hold in general. Because of the replication crisis in psychology and economics [42,43], it would be advisable to replicate the research both in the Czech Republic and in other countries. Since the data were collected three years ago, replication may also be influenced by changes in the macro environment. If the survey is replicated in a national language, slight differences may appear because of the connotation of a specific validated translation. If the statements are used in English, differences may also exist, as was illustrated by the example of the Big Five Inventory-10 in the World Values Survey-Wave 6 (2010-2014) data in [44]. Future research could investigate what aspect(s) of narcissism influence the preferred pricing model using longer questionnaires, such as [45,46].

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