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Is the Tendency to Free Ride Impacting Your Willingness to Pay for Public Healthcare?

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Abstract

Healthcare services differ from other public goods due to the characteristics of their demand and supply. As a public good, its provision might allow for a free rider effect. This study aimed at checking whether a patient's overall tendency to free ride impacts the Willingness to Pay for public healthcare access. The study demonstrates that besides the experience level with the valued good, free riding tendency also influenced the valuation. The results indicate that not only past decisions about free riding but also readiness to free ride in the future might change the willingness to pay for the public good.

Keywords: willingness to pay, preferences, health care financing, public health insurance

JEL Classification: D12, I11, I13

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1 Introduction

Usually, people might be divided into three groups: those who never free ride, those who always free ride and those, who conform to the norm or free ride depending on the behaviour of people from their surroundings (Galizzi et al., 2021). Such a tendency is visible in many experiments and everyday life when an individual decides about her contribution to a public or subsidized good. The free riding effect might also be related to healthcare services. Public healthcare contribution is often deducted from each employee's salary each month, but legislations in some countries allow some groups of citizens to use public healthcare without paying the contribution first. One might wonder - if citizens are given a choice, would they pay the healthcare contribution on their own? Will their previous experience with the good affect their willingness to pay for public healthcare? Will their attitude towards contributions to society and the overall tendency to free ride in life also impact the amount they are willing to pay? Such considerations are crucial for social planners in Poland, especially during changes in national law, that proposed increase in public healthcare contributions. It is also important in discussions, for example in USA, about a need for a compulsory healthcare insurance.
In Poland, the public healthcare system is provided by Narodowy Fundusz Zdrowia (NFZ). By paying a contribution (with monthly taxes deducted from salary or by personal payment to NFZ's bank account) a patient acquires access to all medical facilities run by NFZ. Usage of those healthcare services might feel free of charge due to no additional payment required at the facility. The obligation to pay health insurance contributions is regulated by law and all employees (and additional groups of citizens) are subject to it. However, for any system to work properly, its participants must see the sense of operation and understand how their contributions are used. Additionally, despite the contributions deducted from employees' salaries each month, many NFZ health facilities constantly struggle with insufficient funds allocated by the government for their everyday operations (Rezler, Pastusiak, Jasiniak 2017). Social planners might wonder what is the level of patient satisfaction of the current system and what would happen if citizens could freely decide whether to pay contributions to the public health service and at what amount. Those hypothetical questions may be important in the process of planning changes to the entire system.
The amount the citizens are ready to pay for access to any good (or public healthcare system) depends on a wide range of factors. All characteristics of the good matter, for example, availability, value for money, and expected use of the good. At the same time, the limited or non-excludability from the goods allows for a free rider effect (Fischbacher and Gachter, 2006). This characteristic makes it impossible to exclude an individual from the usage of a public or subsidized good even though the said person was not supporting (or supporting on a low scale) its provision. Due to a free rider effect, customers rely on payments from other individuals and try to evade paying for the goods used.

The amount that patients would be willing to pay for access to public healthcare (if they are given a choice) might, among other factors, be influenced by people's general tendency to free ride in their life. Someone might not feel a need to contribute to society in any area, not only healthcare but also social security, services offered by uniform services (like police or fire brigade), usage of other goods (for example public transport) or security systems in one's neighbourhood. Generally and broadly defined tendency to free ride in many areas might also influence the readiness to contribute to the public healthcare system. Someone feeling empathy and solidarity with society would prefer to contribute to the public good, even if someone else will benefit from it more. Many costly medical treatments are financed from funds gathered from the whole society and our contributions decide whether someone in need will be able to use it.
In this study, I assess whether one's general tendency to free ride in life will influence Willingness to Pay for access to the public healthcare system. Additionally, I check the effect of previous experience with the good to avoid omitted variable bias. Correlation and conditional probability between those two areas are tested. A survey study was conducted on a group of students to test their Willingness to Pay for public healthcare access and their tendency to free ride. Due to current legislation in Poland, it was not possible to assess citizens' revealed preferences, therefore a hypothetical situation was presented to each respondent to understand their stated preferences. Two methods were used to capture the relationships between those two areas: Two-Way ANOVA with interactions model for the evaluation of correlations between studied variables and a Bayesian network for conditional probability assessment between respondent's characteristics and Willingness to Pay.

2 Willingness to pay for healthcare

Government or its subordinate units provisions public goods to society. Part of those goods can be called pure public goods (e.g., national defence, public safety) (Kaul, Grunberg and Marc, 1999). The other part can be called socially essential goods, which would be unavailable to some citizens without government aid (e.g., public education and public healthcare). Samuelson (1954) describes them as non-rivalrous as their usage by an individual does not reduce availability to others. In the definition of Holcombe (1997), public goods are called social goods. They are non-excludable as they are available to use for all individuals. Some public goods could be private, but due to social policy, their provision is often sourced from public funds.
Among the extensive list of public goods, healthcare is often needed in an emergency. During everyday life, we might not even notice its lack or presence, but during dire times only that might save our life. Due to its features, public healthcare stands out from other public goods, and it is not surprising that multiple studies concentrated on the patients' valuation of specific health services or access to the healthcare system. Individuals' demand for health services is not constant - it might be unpredictable

(Arrow, 1963) as much as possible effects of using the services. Patients need to trust medical workers that the services offered will be of the highest quality, as they cannot test what they are paying for before the purchase. On the other hand, medical workers should concentrate on helping patients rather than on maximizing profits. There are many uncertainties in purchasing or opting out of medical services. The question of recovery is as uncertain as the matter of getting sick itself. The difficulty of predicting the disease increases with a lack of experience in going through more severe illnesses. In a competitive economy, the supply of a good is dependent on the return on its production. In the case of health services, a permit is required to start operating (issued a license to practice), which limits supply, and increases the price of medical care. These features make it difficult for patients to properly evaluate the value of access to medical services, especially if they do not have experience in using a paid healthcare system. However, such valuation is crucial for social planners that assess possible and needed changes in the healthcare system.

To properly quantify the benefits of the introduction changes in the public health system, researchers need an effective method of valuation of non-market goods. Often a good's value is determined using experiments with different forms. The acquired valuation takes the form of Willingness to Accept (WTA) and Willingness to Pay (WTP). Willingness to accept might be defined as the lowest price for which a given person is willing to sell, give away or abandon a good he has. Willingness to pay, on the other hand, is the highest price a person is willing to pay to buy a good he does not have (Horowitz & McConnell, 2003).

Willingness to Pay and Willingness to Accept values might be measured by many methods. Those using experiments and survey forms are called stated preferences (SP) methods (Johnson et al., 2017). Two main pillars of SP methods are Contingent Valuation (CV) and Discrete Choice Experiment (DCE). In the former, respondents decide whether they agree to a presented intervention at a given cost. In the latter, respondents select which alternative they prefer from a set of options. Unfortunately, there are many types of effects that might influence the values provided by the respondents. For example, due to Loss Aversion effect (Kahneman and Tversky, 1984), people might state a different WTP based on their loss aversion. The Income effect limits the maximum WTP that a person can think about due the budget available (Hanemann, 1991). The effect of previous experiences changes the attitudes towards the studied good (Ryan and Spash, 2011).

The Contingent Valuation was used in this study to measure only the WTP for access to the public healthcare system. CV method is better suited to studies related to general or holistic changes while DCE will be better for assessment of changes of only parts of the good. Questions related to WTA for a healthcare access change, the problem given to a respondent might be too complicated for a full understanding. Not only because most people are mostly playing the role of the buyer rather than the seller, but also because in healthcare it is difficult to imagine that you can decide

to resign from a better health state or medical treatment. Because of that only WTP was measured, which is a much more familiar value to most citizens.

3 Free riding tendency

Some public goods are related to the voluntary cooperation of people using them. A public good might be provided only after the sum of the society's payments is sufficient. It might occur that people will try to evade paying for public goods based on their beliefs or tendencies. In 1954 Samuelson stated his free rider hypothesis and in 1959 Musgrave said that public goods are always undersupplied - well below the Pareto-optimal amount (Schneider & Pommerehne, 1981). For example, the free riding effect might be expected when the public good is a consumption good.
It might be possible that people evade paying health insurance contributions due to various reasons: the amount is too high, they do not understand what they are paying for exactly, they never use public healthcare or use mostly private healthcare services or they do not feel a solidarity with the society and do not see a reason to pay for others.
The first type of reasons is related to the current law, defining the percentage of gross salary deducted each month for the public healthcare contribution. Due to a lack of market prices, patients (or customers) might have an issue with a proper valuation of public healthcare access (or any other public good). Willingness to Pay value helps to acquire an individual's valuation of a good, which often helps social planners plan prices or contributions related to public goods. A better understanding of patients' Willingness to Pay for access to public healthcare might give crucial information to government agencies defining public healthcare contributions.
The second type of reasons is more related to the temptation to free ride. One may wonder if people would pay a contribution if they never use any of the services which they pay for. Or why she should pay for expensive medical treatment for other patients. Such dilemmas are common in all areas related to social security or insurance contribution contributions. Underfunding of the public healthcare system affects the extent to which all patients may use them. Insufficient amounts provided for medical institutions and healthcare workers result in a decreased amount of goods provisioned. It is visible in e.g., long waiting times for doctor's appointments. Customers evading taxes or contributions affect the situation of the whole society.
There were already experiments conducted that aimed at a better understanding of how people would behave if they have a chance to voluntarily contribute to the public good (Fischbacher & Gachter, 2008). Results show that individuals would either contribute more that could be explained by their self-interest or they would increasingly free ride if they are faced with repeating experiments. Another observed behaviour was so-called 'conditional cooperation', which occurred when individuals' actions depended on how the rest of the group or a society behaves or is believed to

behave. If one observes or believes that others decide to free ride, she will reduce her contribution. Then the overall cooperation in the group might decline.
People might significantly differ in their decisions regarding contributions. Some might act like conditional cooperators and prefer to contribute when they see or believe that others also contribute to the public good provision. Others might not take others into account and prefer to free ride - never contribute anything. Experimental studies (Fischbacher & Gachter, 2008) have shown that both groups might be significant in the size of the society. Additionally, people tend to adjust their beliefs about others' contributions based on observations of others' decisions from the past. After some time, each group member decides to free ride to maximize her income, even when there is no income-based motivation.
Some people might contribute to society due to their beliefs and moral norms related to conditional obligations to others and reciprocity (Bowles & Gintis, 2000). One might not be willing to pay welfare to a free rider who could support themselves. Likewise, tax morale encourages paying taxes if others do the same. It might also occur that the cot-benefit assessment is more important to an individual than the observation of others (Jakubowski & Kuśmierczyk, 2013). In such a situation a person chooses an individually rational strategy of behaviour.

4 Methods

4.1 Design

The research was based on the author's custom survey form. Participation in this study was free of charge and was also not compensated. Answers from each respondent were collected individually and were not shared between participants. The evaluated public good was not provided following the end of the experiment. The experiment had a theoretical character. The respondents were told that the answers collected would help in an assessment of improvements in the Polish public healthcare system (NFZ) expected by patients as well as show needed changes in the pricing of participation in the public healthcare system.
A set of one open-ended and ten close-ended questions were used in this study. The open-ended question was presented in a form of a short scenario. Respondents were asked to imagine, that the law in Poland has been changed and that currently, each citizen can voluntarily pay a contribution for access to the public healthcare system. An example was provided about the amount of the current healthcare contribution deducted from an example salary. Also, general information about healthcare services that respondents will be able to use after paying the contribution was provided. Participants were asked to provide a sum they are willing to pay for access to public healthcare. Closed-ended questions consisted of two groups: socio-demographic characteristics and readiness to free ride in various situations. Free riding was checked in scenarios related to resigning from paying for the public healthcare contribution,

but still using health services provided; a conscious decision about using public transport without a valid ticket (in the past or the future); readiness to pay a voluntary contribution for uniform services and a security cameras' system in respondent's neighbourhood. Respondents' tendency to free ride was evaluated based on a set of separate questions about past and future decisions. The decision stemmed from two reasons. Firstly, literature shows that people do not use all opportunities to free ride, but rather cooperate conditionally (Ledyard, 1995; Camerer, 2000). Therefore free riding tendency was not analysed by the WTP values, but by separate variables. Secondly, questions about past decisions or future scenarios allowed respondents to better understand the problem and answer accordingly to their beliefs and attitudes. As there are scarce studies combining free riding effect in everyday life with the valuation of access to public healthcare, variables used for assessment of individual's tendency to free ride were selected based on a literature review related to either free riding effect in general or free riding in healthcare. Author is not familiar with other studies in this area that could suggest a proper variables' list, therefore the dependent variables are selected based on the examples of free riding effect examples found in the literature.

The propensity to use the free-rider effect was assessed using separate questions regarding past decisions and the respondent's declared behaviour in the future. Experiments have already been carried out on the strategic use of the free-rider effect and conditional cooperation in the valuation of a given good (Ledvard, 1995; Camerer, 2000). In the context of access to medical services, the free rider effect resulting from the use of the possibility of obtaining medical services without paying a fee and without paying a health insurance contribution was studied (Kahn, 2011; Armand, 2021). On the other hand, the free-rider effect was also studied in the context of, for example, conscious use of public transport without a valid ticket or taking advantage of safety and security without paying for the provision of these services (Galor, 2010; Mendoza, 2015). So far, however, these areas have not been combined and it has not been compared whether the use of this effect in one area (e.g. in public transport) also affects its use in the other area of life (e.g. in the health care system).

The aim of this study was to indicate whether there is a relationship between the use of this effect in the use of public transport or security provided by uniformed services and monitoring the area of *readiness to pay* for the health insurance contributions. The tendency to use the free rider effect was not determined on the basis of the obtained WTP values for access to the health care system, as is the case in research on avoiding paying health insurance contributions (Armand, 2021), but on the basis of variables determining its use in the case of other goods.

Variables used in the survey together with their definitions were presented in Table 1. The general tendency to use the free rider effect was determined using four variables. They concerned two areas: the use of public transport without a valid ticket and the use of security provided by uniformed services and monitoring of the area of the place of residence without co-financing. These areas refer to the relatively often mentioned

in the context of the free-rider effect of public transport and national defence - compare Galor (2010).

Table 1: The set of variables used in the study

Name	Meaning
WTP	Respondent's WTP for access to the public healthcare measured as monthly contribution
Experience	The respondent's frequency of use of public healthcare
No Ticket Past	Respondent's decision to travel in public transport without valid ticket in the past
No Ticket Future	Respondent's readiness to travel in public transport without valid ticket in the future
Vol Unif Services	Respondents' readiness to pay a voluntary contribution for uniformed services
Vol Security Cam	Respondents' readiness to pay a voluntary contribution for security cameras in the neighbourhood
Age	Respondent's age
Sex	Respondent's sex
Education	Respondent's level of education
Population Residence	Population of respondent's place of residence
Income Source	Respondent's main income source

4.2 Procedure

Collected data was analysed for the presence of correlation and/or causation between variables used. Three methods were used: Two-Way ANOVA with interactions model, linear regression model and a Bayesian network.
The usage of the Two-Way ANOVA model depends on several assumptions that need to be fulfilled: homoscedasticity - homogeneity of variance, independence of observations, and normally distributed dependent variable. All variables used in the Two-Way ANOVA model were tested against heteroscedasticity with the use of the Breusch-Pagan Test and visual assessment of Normal Q-Q and Residuals plots. No heteroscedasticity of residuals was noticed. As the dependent variable - WTP - was not normally distributed, log values of this variable were used for the model fitting. The usage of interactions in the model allowed for testing the differences in means between groups divided by individual variables representing free riding tendency but also iterations between them, possibly presenting results of enhanced effects. Combinations of groups created by the model were compared with each other by the Tukey Honest-Significant-Differences test. This post-hoc test gives a broader insight into specific levels of variables analysed that were different. Results of Tukey

HSD test were also insightful for the control for the Type I error rate across multiple comparisons.
For further analysis only the significant relationships were presented from the ANOVA and linear regression models. For Two-Way ANOVA with interactions model all variables with all possible sets (consisting of up to 3 variables in a set) were analysed independently. For linear regression model the backward stepwise selection procedure was used, where the interaction found as significant by the ANOVA model was also provided.
The Bayesian network was used in the second stage of the analysis (Stephenson, 2000). It is a graphical model that contains information about the conditional dependence structure between variables, based on the Bayes theorem:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

where:

$P(A|B)$ - is a conditional probability of event A occurring when B is true;

$P(B|A)$ - is a conditional probability of event B occurring when A is true;

$P(A)$ - probability of event A occurring;

$P(B)$ - probability of event B occurring;

The model uses the Bayes theorem in order to find the causal probability relationships between variables. There are three main elements of the model:

V - a set of variables, represented as nodes of the graph;

A - a set of conditional relationships, represented as directed arcs between variables;

P - a set of conditional probabilities related to all variables and their respective parents.

The set of directed arcs (A), together with the set of variables (V) create a directed acyclic graph (DAG) with a graphical structure $G = (V, A)$ and a set of conditional probabilities $P = (v|\pi_y) : v \epsilon V$ and π_v is a set of parents of v. The created graph must contain only directed arcs and cannot contain loops or cycles. Using a set of variables, directed arcs between those variables and their set of conditional probabilities the model indicates which variables and to what extent influence the given variable.
There are two main steps needed for model learning (Liu et al., 2016). Firstly, a constraint-based or score-based algorithm is used for network structure learning. In the result a DAG is discovered, that best describes the causal relationships in the data. After this step each relationship found should be validated and all arcs should receive a direction. It might be needed to flip, remove or add an edge based on empirical beliefs or expert knowledge. Some statistical packages allow for validation of the

direction of indirected arcs. This is a crucial step that might transform a dependence found in the data into causation. In the second step, the parameters of the local distribution functions are estimated by the maximum likelihood estimator. For each variable present in the network there is a conditional probability table calculated, that contains all possible configurations of the values of the parents of the variable.
As correlations do not always mean causation, such a model allows for a better understanding of the power and direction of influence between areas studied. In comparison to other statistical tools, the Bayesian network model allows for a deep understanding of causal probability relationships not only between two variables, but also taking into consideration the whole set of variable's parents. Therefore it is also possible to discover an indirect relationship between variables. A Bayesian network is a tool that can visualise how probable is a given scenario and what is the true relationship between variables. Usage of such model allowed for a better understanding of the effects that occurred between the variables used.
There are three assumptions needed for causality (Koller, 2009):

1. The causal Markov assumption - each variable is conditionally independent of its non-effects (direct and indirect), given its direct causes.

2. The d-separation assumption - a DAG needs to present the probability distribution of variables, given the d-separation of dependencies in the DAG.

3. The latent variable assumption - no latent variables are allowed as they might act as confounding factors.

The last assumption is related to the first two. Existence of an unobserved variable influencing other variables introduce bias in the causal network. Violation of those assumptions does not allow for a causal interpretation of the relationships found.
In order to check the assumptions, a latent variable was added to the model and it's values were fitted based on The Structural Expectation-Maximization (Structural EM) algorithm. An arc placed by the model between this latent variable and another node means that there is an omitted variable detected and the graph is not causal. Conditional independence and d-separation assumptions were also tested.

4.3 Subjects

The survey respondents consisted of 100 students of the Higher School - Education in Sport in Warsaw (orig. Wyższa Szkoła - Edukacja w Sporcie w Warszawie). In total 89 survey forms were completed in full. All the information obtained was stored anonymously and processed in accordance with the data confidentiality requirements as foreseen by Polish law. The small sample size used in this research was related to the limited number of students the author had access to due to the consent to the study received from the College's authorities. Due to this limitation, the findings of this study are adequate to the respondents' demographic group.

The questioned individuals had the following dominating demographic characteristic. In brackets the percentages of people with such characteristics found in this specific sample were compared to the percentages found in the general population (Czapinski and Panek, 2015):

age - 22-24 year-olds (47% vs 29.2%);

sex - female (74% vs 51.7%);

education level - Bachelor/Engineer degree (45% vs 20.7%);

population of the place of residence - more than 500 thousand (25% vs 11.9%) and between 100 and 500 thousand (25% vs 17.3%) inhabitants;

main source of income - work (79% vs 40.9%).

Respondents were willing to pay mostly between 50 and 100 PLN for access to the public healthcare system. The values provided by study participants were mostly below 100 PLN, with the mean at 54 PLN and the median at 45 PLN.

5 Results

Respondent's decisions regarding the usage of public goods and readiness to free ride were proven impactful on the Willingness to Pay for access to public healthcare. Especially such decisions like usage of public transport without a valid ticket in the past and readiness to contribute to security cameras used in the respondent's neighbourhood impacted the WTP stated. There was also a visible effect of experience in using public healthcare.

5.1 Correlation

As expected, the frequency of public healthcare usage was correlated with the Willingness to Pay for access to such services. Two areas related to the tendency to free ride were also proven as correlated with WTP. The first one was related to the usage of public transport without a valid ticket, which the respondent committed in the past (and was ready to admit it). The other one presented the respondent's readiness to contribute to an investment that could improve the security of the whole neighbourhood. The means of WTP stated in groups divided by interactions of those two variables were also statistically different. Table 2 presents the results of Two-Way ANOVA with interactions model. Due to its large size, Table A1 with results of the Tukey multiple comparisons of means was placed in the Appendix. Both Table 2 and Table A1 feature statistically significant results only.
To assess the sign and strength of the correlation between the variables chosen in the previous step, a linear regression model was built. The results presented in Table 3

suggest that there is a positive correlation between almost all of the analysed areas besides *No Ticket Past* and the interaction of *No Ticket Past* and *Vol Security Cam* variables. They show that the respondents' WTP increases as they gain experience in using public healthcare services. It is also higher when they are more ready to contribute to neighbourhood safety in a form of security cameras. The WTP decreases significantly when the respondent used public transport without a valid ticket in the past and decreases to a smaller extend when at the same time the respondent was a free rider in public transport, but hesitates whether to contribute to the neighbourhood safety now.

Table 2: Two-Way ANOVA with interactions model results (only variables with significant differences in groups)

Variable	F	p-value
Experience	27.59	2.21e-05***
No Ticket Past	7.02	0.02*
Vol Security Cam	3.50	0.03*
No Ticket Past : Vol Security Cam	3.56	0.03*

Note: * p<0.05; ** p<0.01; *** p<0.001.

Table 3: Linear regression model results

Variable	Estimate	Std. Error	t value	p.value
(Intercept)	-55.77	23.48	-2.37	0.01*
ExperienceSeveral times a month	31.78	11.22	2.83	5.84e-03**
ExperienceSeveral times a week	48.00	13.67	3.51	7.34e-04***
No_Ticket_PastYes	-22.05	11.34	-1.94	0.02*
Vol_Security_Cam5	13.85	3.07	4.50	2.24e-05***
No_Ticket_PastYes:Vol_Security_Cam3	-9.77	3.71	-2.63	0.01*

Note: * p<0.05; ** p<0.01; *** p<0.001.

Respondents who often use public healthcare stated, on average, significantly greater Willingness to Pay for access to such services than those, who never used it, or visited public healthcare facilities several times a year at most (Table A1). The average WTP stated was higher in a group of respondents who never used public transport without a valid ticket than in a group of free riders. The average valuation was also higher when individuals had more significant intentions to contribute to security cameras installation (at the level of 8-10 on the 1-10 scale) in comparison to those that were not interested in such investments (at the level of 1-5 on 1-10 scale). The interactions between those two areas related to free riding gave the expected

results. The average valuation given by respondents who never used public transport without a valid ticket and those who were willing to contribute to the financing of investments increasing the security of the neighbourhood was higher than the average valuation stated by free riders. The element of interactions between the variables gives an interesting additional information. Respondents, who acted as free riders in the past gave lower valuations of access to the public healthcare system than the rest of the group. However, when a public transport free rider was at the same time not completely certain whether he or she would like to contribute to the security cameras, the expected effect was not so negative. Such result might suggest two things. Firstly it shows that past and present decisions might have different effects on the studied valuation and reduce each other's strength. Secondly, it shows that respondents chose a particular behaviour based on their attitudes towards a specific good. They might have cared more about their security, which also in an extend involved the access to health services.

Surprisingly, respondents' readiness to free ride in the future, in a form of travelling without a valid ticket in public transport, was not correlated with the WTP for public healthcare access. Figure 1 presents the difference in density of WTP stated in relation to free riding in the past or the future. One might notice visible differences in densities between WTP stated by those who were a free rider in the past and those who were not (Figure 1B). The average WTP stated by free riders was equal to PLN 34 and by individuals from the other group - PLN 77. Densities of WTP stated in groups divided by the readiness to free ride in the future were similar to each other (Figure 1A). Individuals who were ready to free ride in the future stated an average WTP of PLN 48 and those who are not ready to free ride - PLN 63.

Figure 2 presents densities of WTP stated in relation to *Experience* and *Vol Security Cam* variables. By looking at the density of public healthcare access valuation in relation to experience with the usage of such services, one may notice that greater values were given by individuals who often used public healthcare (Figure 2A). It might indicate that people prefer to pay more for goods that they often use and know well. In the free riding-related variable *Vol Security Cam*, the differences in WTP values stated by respondents with different readiness to contribute to the security cameras were significant. Those ready to contribute gave a higher valuation than those who were only partially sure. Those who were not ready to contribute were also not ready to pay much for public healthcare (Figure 2B).

5.2 Conditional probability

The Bayesian network was used to assess the dependence structure of the variables used in the study. Graph representation of the model was presented on Figure 3. Additional *Latent* variable was added to ensure that no variables were omitted during the preparation of the model.

Figure 1: Relationship between WTP and decision about using public transport without a valid ticket in the future (A) and in the past (B)

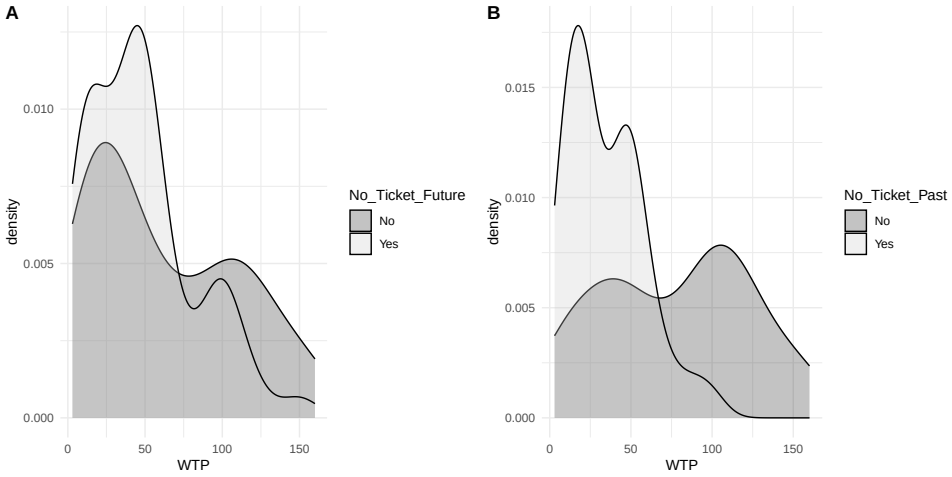


Figure 2: Relationship between WTP and previous experiences with public healthcare (A) and readiness to contribute for security cameras (B)

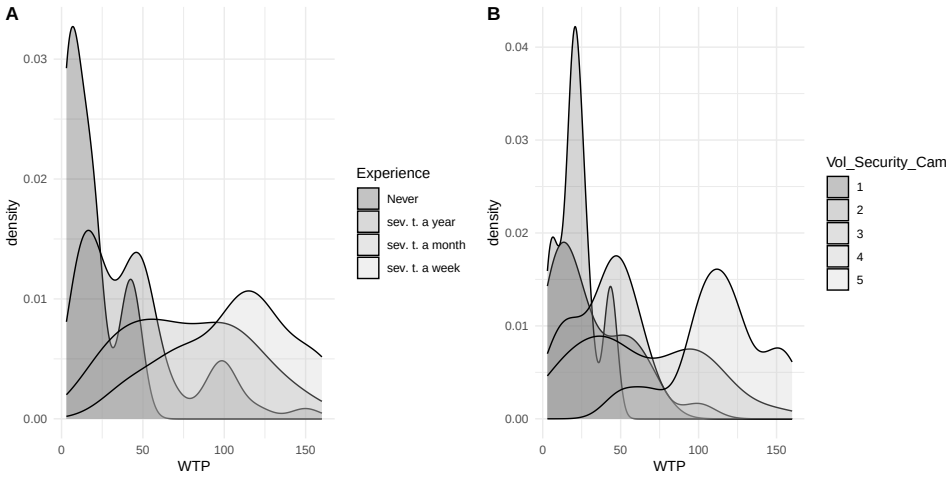
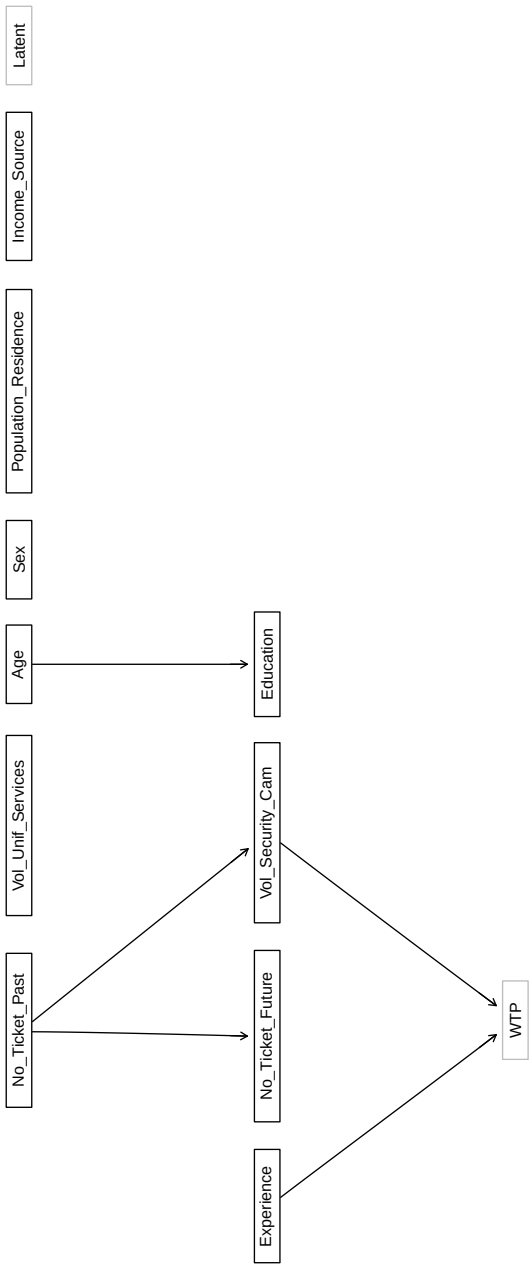


Figure 3: The Bayesian network and relationships between variables used



The final version of this additional variable consisted of three levels. The selection was made based on comparison of models with a different version of the *Latent* variable. The Structural Expectation-Maximization (Structural EM) algorithm was used for data input for this additional variable. Based on 150 iterations of model's parameters fitting, the network has not detected any relationship between the *Latent* variable and the variables originating from the study. Regarding the remaining causality assumptions, all variables in the graph were tested for conditional independence of their non-effects, both direct and indirect, given its direct causes. D-separation was proven for all connected nodes. Together with the assumption regarding a latent variable, the relationships presented by the network might suggest a causal effect. However, due to the studied group characteristics (non-representativeness), the results might be biased. This is why only a structure of relationships detected is interpreted, in accordance to the data collected. Broader research, based on a wider group of respondents is needed to confirm the causal relationship.

As expected based on the results of the ANOVA model, experience in the usage of public healthcare services and areas related to free riding such as readiness to contribute to neighbourhood security improvement and usage of public transport without a valid ticket in the past were related to the Willingness to Pay for public healthcare. Surprisingly two variables related to free riding were connected. The readiness to contribute to security cameras and to free ride in the future were related to the past decisions about free riding in public transport. Additionally, as one could expect, age influenced the level of education of the respondent.

Table A2 presents conditional probabilities for the node representing Willingness to Pay for public healthcare access, Table A3 for the node representing readiness to free ride in the public transport in the future, Table A4 for node related to readiness to contribute to security cameras and Table A5 to the node representing respondent's education level. Due to the large size of those tables they were placed in Appendixes with empty parts omitted.

Conditional probabilities suggest that respondents more motivated to contribute to security cameras investment, who at the same time often used public healthcare services, were more likely to provide a high valuation of access to public healthcare (between 80 and 160 PLN). On the other hand, those who were not ready to contribute to the neighbourhood safety and never used public healthcare were ready to pay only between 3 and 20 PLN for access to public health services. The decisions made in the past regarding free riding in public transport were related to both readiness to repeat such behaviour in the future and to use the free-riding effect in other area like security. Respondents who did not act as free riders in the past were mostly not tempted to do so in the future. They also were ready to contribute to the neighbourhood's safety. As expected, age was related to respondents' education level. This relationship might be also related to the structure of the studied group, consisting of students from a few levels of higher education. Following the results of the ANOVA, a few variables related to free riding were not related to the valuation. Readiness to travel in public

transport without a valid ticket in the future as well as readiness to contribute to the uniform services were not added to the DAG.

6 Summary and conclusions

Citizens expect that the government will provide public goods in sufficient quantity and quality. They react negatively when they hear about the growing waiting time for a doctor's appointment. At the same time, a significant part of society cannot properly value public goods' provision costs and understand how important their contribution is. The untypical characteristics of healthcare services as a good are not helping patients in a proper valuation of access to the public healthcare system. The willingness to Pay indicator allows for a better understanding of customers' true beliefs, also in such difficult, but crucial areas as health. In this research, only two types of determinants were chosen for the analysis of the valuation, namely free riding tendency and socio-demographic characteristics.

The public healthcare services offered in Poland are specific just as much as patients' attitudes towards paying for private healthcare system access. As Pajewska-Kwaśny (2016) has shown, patients in Poland are reluctant to buy additional healthcare insurance. It might explain the lack of 'protest' answers with 0PLN values provided by the respondents of this research. By paying a small amount, similar to the current contribution deducted from the salary, they would like to stay at their status-quo position rather than trying something else. Unlikely Horowitz and McConnell (1999), my research shows that age was not related to the valuation of healthcare access. Overall low values obtained for the valuation, in the case of access to public healthcare, confirm the results of other research, where goods with close substitutes were given lower values of WTP and WTA/WTP coefficient (Shogren J. et al., 1994). Free riding behaviour might occur in groups of well-educated people, who at the same time tend to undervalue their mean WTP for strategic reasons (Hackl & Pruckner, 2005). In this research, though, the main income source and education levels were not significantly correlated the valuation.

Results from this research have shown, that there might exist a relationship between a free riding tendency and the valuation of access to a public good. Groups of respondents, divided based on their characteristics and readiness to free ride, noted different values of WTP for public healthcare access. The Bayesian network used has not detected a relationship between a latent variable added, despite numerous variable's specifications and starting points of fitting. The variables added to the DAG were also tested for d-separation and conditional independence. Meeting the causality assumptions might not be enough due to the studied group characteristics. Additional study, based on representative group of respondents is needed to confirm that the relationships found are truly causal. Have there been causal relationships found, they would suggest that observation of a citizen's decisions regarding her usage of free riding effect in some areas might also mean that she would try to use the

effect in the health care system. Such finding is especially crucial for governments of countries, where compulsory health insurance is not present. Relationship and correlation between the usage of the free riding effect in various areas of life might suggest that such compulsory insurance is needed, especially in societies, where a high number of public transport free riders and tax evaders were found.
The results of this research may be valuable for individuals who plan a campaign targeted at people evading taxes, contributions, and other payments for government-financed or subsidized goods. Their action may help the citizens to better understand the value of those goods and encourage them to contribute to their provision. One example of such interventions is related to the information provided and plan insurance recommended to the patients as suggested in the work of Handel et al. (2015). The public healthcare sector should be promoted for an appropriate development aimed at meeting patient's needs. As stated in the study of Mathiyazaghan (1998) it might occur that patients are more willing to join an health insurance than to pay contributions. A detailed comparison between vaccine refusal and free riding (Bradley and Navin, 2021) suggest that the government might consider the usage of small incentives or disincentives for the citizens' behaviour. Properly aimed and prepared, it might reduce the free riding effect and increase the WTP value.
The research presented is a beginning of a wider topic related to variables influencing the value of WTP in the terms of healthcare services. This study had a limitation related to the demographic characteristics of the studied group. Respondents did not represent the general population, as they consisted mostly of young woman. It might be a source of bias and therefore does not allow to define regularities existing in society. Unfortunately the consent to the study from the College's authorities, based on which the study was conducted, allowed for questioning only a limited group of students. The author plans to extend the study to a wider study group in the future in order to compare the results with a more representative group.

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References

[1] Armand A., Augsburg B., Bancalari A., (2021), Public Service Delivery and Free Riding: Experimental Evidence from India, CEPR Discussion Paper DP16284.

[2] Arrow K.J., (1963), Uncertainty and the Welfare Economics of Medical Care, The *American Economic Review* 53(5), 941–973.

[3] Bowles S., Gintis H., (2000), Reciprocity, self-interest, and the welfare state, *Nordic Journal of Political Economy* 26, 33–53.

[4] Bradley E., Navin M., (2021), Vaccine Refusal Is Not Free Riding, *Erasmus Journal for Philosophy and Economics* 14(1), 167–181.

[5] Camerer C.F., (2000), *Behavioral Game Theory. Experiments in Strategic Interactions*, Princeton.

[6] Czapinski J., Panek T. [ed.], (2015), Social Diagnosis 2015 - Objective and subjective quality of life in Poland, Contemporary Economics - Quarterly of University of Finance and Management in Warsaw 9(4), 1–547.

[7] Fischbacher U., Gachter S., (2008), Social Preferences, Beliefs, and the Dynamics of Free Riding in Public Good Experiments, CESIFO Working Paper 2491, 1–31.

[8] Fischbacher U., Gachter S., (2006), Heterogeneous Social Preferences and the Dynamics of Free Riding in Public Goods, IZA Discussion Paper 2011, 1–42.

[9] Hanemann W., (1991), Willingness to pay and willingness to accept: how much can they differ?, *The American Economic Review* 813, 635–647.

[10] Galor Z., (2010), Socjologiczno-własnościowy sens „problemu gapowicza" - stosunki lumpenwłasności w Polsce. Odmiany życia społecznego współczesnej Polski instytucje - polityka - kultura. Red. Z. Galor. Wydawnictwo Naukowe Wyższej Szkoły Nauk Humanistycznych i Dziennikarstwa w Poznaniu: Poznań, 63–78.

[11] Galizzi M., Lau K., Miraldo M., Hauck K., (2021), Bandwagoning, free-riding and heterogeneity in influenza vaccine decisions: An online experiment, *Health Economics* 31, 614–646.

[12] Hackl F., Pruckner G., (2005), Warm glow, free-riding and vehicle neutrality in a health related contingent valuation study, *Health Economics* 14, 293–306.

[13] Handel B., Kolstad J., Spinnewijn J., (2015), Information frictions and adverse selection: policy interventions in health insurance markets, NBER Working Paper Series 21759, 1–79.

[14] Holcombe R., (1997), A Theory of the Theory of Public Goods, *Review of Austrian Economics* 10, 1–22.

[15] Horowitz J.K., McConnell K.E., (2003), Willingness to accept, willingness to pay and the income effect, *Journal of Economic Behavior & Organization* 51(4), 537–545.

[16] Jakubowski R.M., Kuśmierczyk P., (2013), „Jazda na gapę" jako rezultat dopasowani do obserwowanego społecznego zaangażowania w wytwarzanie dobra publicznego - wyniki badań eksperymentalnych, Zeszyty Naukowe Wyższej Szkoły Bankowej we Wrocławiu 2(34), 215–224.

[17] Johnson R., Boyle K., Adamowicz W., Bennett J., Brouwer R., Cameron T., Hanemann W., Hanley N., Ryan M., Scarpa R., Tourangeau R., Vossler C., (2017), Contemporary Guidance for Stated Preference Studies, *Journal of the Association of Environmental and Resource Economists* 4(2), 319–405.

[18] Kahn D., Kahn J., (2011), Free Rider: A Justification for Mandatory Medical Insurance Under Health Care Reform?, *Michigan Law Review First Impressions* 109, 78–85.

[19] Kahneman D., Tversky A., (1984), Choices, Values and Frames, *American Psychologist* 39, 341–350.

[20] Kaul I., Grunberg I., Stern M., (1999), Defining Global Public Goods, [in:] Global Public Goods: International cooperation in the 21st century, [eds.:] Kaul I., Grunberg I., Stern M., Oxford University Press, 2–19.

[21] Koller D., Friedman N., (2009), *Probabilistic Graphical Models: Principles and Techniques* (1st ed.), The MIT Press.

[22] Ledyard J.O., (1995), Public goods: A survey of experimental research, [in:] Handbook of Experimental Economics [ed.:] Kagel J., Roth A., Princeton, 111–194.

[23] Liu S., McGree J., Ge Z., Xie Y., (2016), Classification methods, [in:] Computational and Statistical Methods for Analysing Big Data with Applications, [eds.:] Liu S., McGree J., Ge Z., Xie Y., Academic Press, 7–28.

[24] Mathiyazaghan K., (1998), Willingness to pay for rural health insurance through community participation in India, *The International Journal of Health Planning and Management* 13(1), 47–67.

[25] Mendoza J., (2015), The protection of private property: the government as a free-rider, *Economics of Governance* 16, 179–205.

[26] Pajewska-Kwaśny R., (2016), Możliwości implementacji w Polsce wybranych aspektów amerykańskiego systemu ubezpieczeń zdrowotnych, *Ekonomia i Prawo w Ochronie Zdrowia* 1, 95–111.

[27] Rezler D., Pastusiak R., Jasiniak M., (2017), Impact of Restructuring Act of 2005 to the Healthcare in Poland, *Przedsiębiorczość i Zarządzanie* 18, 271–283.

[28] Ryan M., Spash C., (2011), Is WTP an attitudinal measure? Empirical analysis of the psychological explanation for contingent values, *Journal of Economic Psychology* 32, 674–687.

[29] Samuelson P., (1954), The Pure Theory of Public Expenditure, *The review of Economics and Statistics* 36(4), 387–389.

[30] Schneider F., Pommerehne W.W., (1981), Free riding and collective action: An experiment in public microeconomics, *The Quarterly Journal of Economics* 96(4), 689–704.

[31] Stephenson T.A., (2000), *An Introduction to Bayesian Network Theory and Usage*, Dalle Molle Institute for Perceptual Artificial Intelligence.

Appendix A

Appendix A.1 Results of Tukey multiple comparisons of means

Table A1: Tukey multiple comparisons of means results (only statistically significant groups presented)

Variable	group1	group2	diff	p.adj	signif
Experience	Never	Several times a year	1.278	3.67e-05	***
	Never	Several times a month	1.783	0.01e-05	***
	Never	Several times a week	2.183	0.000	***
	Once a year	Several times a year	0.603	0.040	*
	Once a year	Several times a month	1.108	9.41e-05	***
	Once a year	Several times a week	1.508	1.56e-05	***
	Several times a year	Several times a week	0.905	0.001	***
No Ticket Past	No	Yes	-0.774	6.06e-05	***
Vol Security Cam	1	9	1.381	0.032	*
	1	10	1.533	0.021	*
	2	8	1.261	0.022	*
	2	9	1.782	6.26e-04	***
	2	10	1.933	5.33e-04	***
	3	8	1.620	0.012	*
	3	9	2.140	4.82e-04	***
	3	10	2.292	3.67e-04	***
	4	9	1.581	0.002	**
	4	10	1.733	0.001	**
	5	9	1.321	0.007	**
	5	10	1.473	0.005	**
No Ticket Past : Vol Security Cam	Yes:1	No:10	1.533	0.049	*
	Yes:2	No:9	1.782	0.002	**
	Yes:2	No:10	1.933	0.001	**
	Yes:3	No:8	1.620	0.027	*
	Yes:3	No:9	2.140	0.001	**
	Yes:3	No:10	2.292	8.16e-04	***
	Yes:4	No:9	1.581	0.004	**
	Yes:4	No:10	1.733	0.003	**
	No:5	No:9	1.967	0.001	**
	No:5	No:10	2.118	0.001	**

Note: ∗p<0.05; ∗∗p<0.01; ∗ ∗ ∗p<0.001.

Appendix A.2 Conditional probability table for node Willingness to Pay for public healthcare access

Table A2: Conditional probability table for node Willingness to Pay for public healthcare access

		Experience			
Vol Security Cam	WTP	Never	Several times a year	Several times a month	Several times a week
1	[3, 20]	0.98	0.00	0.25	0.71
	(20, 45]	0.00	0.25	0.25	0.14
	(45, 80]	0.00	0.74	0.25	0.14
	(80, 160]	0.00	0.00	0.25	0.00
2	[3, 20]	0.79	0.49	0.01	0.59
	(20, 45]	0.20	0.49	0.96	0.39
	(45, 80]	0.00	0.00	0.01	0.00
	(80, 160]	0.00	0.00	0.01	0.00
3	[3, 20]	0.65	0.01	0.25	0.26
	(20, 45]	0.33	0.01	0.25	0.26
	(45, 80]	0.00	0.96	0.25	0.42
	(80, 160]	0.00	0.01	0.25	0.05
4	[3, 20]	0.25	0.00	0.00	0.35
	(20, 45]	0.25	0.33	0.00	0.17
	(45, 80]	0.25	0.33	0.33	0.17
	(80, 160]	0.25	0.33	0.65	0.29
5	[3, 20]	0.25	0.00	0.00	0.00
	(20, 45]	0.25	0.00	0.00	0.00
	(45, 80]	0.25	0.00	0.20	0.33
	(80, 160]	0.25	0.99	0.79	0.65

Appendix A.3 Conditional probability table for node Travel in public transport without valid ticket in the future

Table A3: Conditional probability table for node Travel in public transport without valid ticket in the future

No Ticket Future	No Ticket Past	
	No	Yes
No	0.62	0.26
Yes	0.37	0.73

Appendix A.4 Conditional probability table for node Voluntary Contribution for Security Cameras

Table A4: Conditional probability table for node Voluntary Contribution for Security Cameras

Vol Security Cam	No Ticket Past	
	No	Yes
1	0.00	0.26
2	0.00	0.26
3	0.20	0.30
4	0.44	0.16
5	0.34	0.00

Appendix A.5 Conditional probability table for node Education

Table A5: Conditional probability table for node Education

	Age				
Education	19-21	22-24	25-27	28-30	31-33
Secondary	0.00	0.42	0.46	0.81	0.95
BA	0.00	0.00	0.39	0.17	0.02
MA	0.98	0.57	0.13	0.01	0.02