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To Bike or not to Bike? Application of the Theory of Planned Behavior in Predicting Bicycle Commuting Among Students in Zagreb

Marina Milković

Centre for Social Welfare, Velika Gorica, Croatia

Marina Štambuk

Department of Psychology, Centre for Croatian Studies, University of Zagreb, Croatia

Abstract

Reducing motorized transport has a number of positive effects on the environment and the quality of human life. Studies that provide better understanding of factors relevant to the choice of transport modes can help in creating campaigns to encourage use of environmentally friendly transport. The main goal of this study was to test the usefulness of the Theory of planned behavior (TPB), with the addition of personal norm, in predicting the intention of commuting by bicycle to university among students in Zagreb, Croatia. The data were obtained from 712 students at the University of Zagreb using an on-line survey. The results show that students mostly used public transport to go to university and that cycling is the second most common choice. The frequency of bicycle use differed due to the distance between the university and participant's home. Bicycle use first increased with the distance and then dropped at the category from 2 to 5km when it started to decrease and was the least frequent at distances longer than 10 km. All TPB components were significant predictors and explained 55% of the variance in intention of commuting by bicycle. Adding personal norm to the components of TPB made a small but significant contribution in explaining variance of the intention (additional 2%) at the same time personal norm was the weakest predictor. Practical and theoretical implications of the results are discussed.

Keywords: Theory of planned behavior, personal norm, mode of transport, bicycle, commuting

Introduction

In recent decades, both the number of cars and trips made by car increased. Today, commuting distances in everyday life are considerably longer which favors car use and discourages walking or bicycle commuting. Many negative effects on the environment are partially caused by massive car use: consumption of non-renewable

✉ Marina Štambuk, Department of Psychology, Centre for Croatian Studies, University of Zagreb, Borongajska 83d, 10000 Zagreb, Croatia. E-mail: *mstambuk@hrstud.hr*

energy sources, air pollution and the devastation of urban space due to the expansion of traffic infrastructure (Freund & Martin, 2007). Additionally, negative impact on human health is present through decreased physical activity and increased number of traffic accidents. To conclude, increased "automobilization" is harmful on many levels and it is crucial to promote the use of environmentally friendly modes of transport, especially those that include physical activation.

Commuting and bicycle use as a form of recreation is common in the cities of developed countries. It contributes to the humanization of urban space and improvement of life quality (Lukić, Prelogović, & Rihtar, 2011). For example, in Copenhagen 37% and in Amsterdam 54% of all daily trips are done by bicycle (Centraal Bureau voor de Statistiek, 2008; as cited in Engbers & Hendriksen, 2010). On the other hand, in Zagreb less than 3% of all daily trips are done by bicycle (PRESTO, 2011). Also, there is a high dissatisfaction with the development and quality of the cycling infrastructure. Students evaluate bicycle lines and parking places below average (Lukić et al., 2011). Not surprisingly, nearly three-quarters of student cyclists do not feel safe or feel only partially safe while cycling in Zagreb. In the same study, students emphasized that greater traffic safety, more developed traffic culture and student discounts for bicycle purchase would motivate them to use the bicycle in the first place or to use it more often. It is obvious that Zagreb can hardly be compared to some Western and Northern European cities when it comes to commuting by bicycle. However, there were substantial changes in recent years brought by greater involvement of cyclists in demanding their rights as traffic participants through organizations that promote bicycle use (e.g. "Sindikat biciklista" [Cyclists' Union], "Zelena akcija" [Green Action]) and protest rides (so-called "critical mass").

The Determinants of Cycling Behavior

The reasons why people choose to commute by bicycle are various. In the following paragraphs, we will describe research results regarding correlates of commuter cycling according to Willis, Manaugh, and El-Geneidy's (2013) categorization.

Physical environment factors represent the built and the natural environment as well as characteristics of the trip. One of the most important factors in this group is cycling infrastructure (Pucher, Dill, & Handy, 2010). Both cyclists and non-cyclists agree that more paths and safer bicycle parking would encourage them to cycle more (Akar & Clifton, 2009). Although cyclists value cycling infrastructure as being of good quality, that is not essential for their decision to cycle. For example, Goetzke and Rave (2011) found that the probability of cycling to work or school in 20 German municipalities is largely independent of the city's cycling infrastructure and the way its government promotes cycling. Traveling distance is also one of the important physical environment factors and its effect on cycling is not linear (Heinen, Maat, &

Van Wee, 2011). Cycling is less frequent at the shortest (less than 5 km) and the longest distances (more than 10 km), while it is more likely at medium distances. The perception of distance and required travelling time differs between cyclists and non-cyclists in the way that non-cyclists overestimate both the distance and the traveling time (De Geus, De Bourdeaudhuij, Jannes, & Meeusen, 2008; Engbers & Hendriksen, 2010). Finally, bad weather is often referred to as a strong factor that prevents cycling (Heinen, Van Wee, & Maat, 2010).

Personal factors which include socioeconomic and demographic characteristics are inconsistently associated with bicycle use. People with the same socioeconomic background often choose different modes of transport (Heinen et al., 2010). Moreover, it seems that the association between socioeconomic factors and the use of bicycles varies depending on the country where the research is conducted. For example, in countries with high cycling mode share, such as Belgium or the Netherlands, there are no gender differences, while men cycle more often in countries where bicycles are used less in general (Garrard, Rose, & Lo, 2008).

Psychological and social factors are the broadest category representing perceptions, attitudes, habits, and social environment. In this group of factors, the most common reasons for commuter cycling among cyclists are: convenience and health benefits/opportunity to exercise (Engbers & Hendriksen, 2010; McCarthy, 2011; Sissons Joshi & Senior, 1998) enjoyment and financial reasons (McCarthy, 2011; Sissons Joshi & Senior, 1998) as well as doing something good for society and nature (McCarthy, 2011). When it comes to differences between cyclists and non-cyclists, it is important to point out that those who cycle to work have significantly higher social support as compared to those who do not (De Geus et al., 2008). Results of the same research have shown that cyclists perceive greater self-efficacy and more ecological-economic awareness about the bicycle as a cheaper and better mode of transport for the environment. Non-cyclists perceive more barriers to cycling, such as more health problems and external barriers as well as lack of time, skills and interest to cycle. Finally, the decision to use the bicycle is often made in comparison to costs, time and safety with other modes of transport (Heinen et al., 2010). Important correlates of the decision to use a bicycle are attitudes about cars and car use. Steg (2005) has shown that a car stands for much more than its instrumental functions like speed, flexibility and convenience. Symbolic and affective functions (sense of excitement, superiority or power, symbolism of independence, success, status, and identity) for many make car use difficult to give up.

The Prediction of Commuting by Bicycle

One of the most common theories applied to predict the intention to use different modes of transport, including bicycles, is Ajzen's theory of planned behavior – TPB (Ajzen, 1991). The main concept of this theory is the *intention* that represents the amount of effort that a person is willing to invest to perform a particular behavior. According to this theory, more positive attitudes toward the specific behavior, a more pronounced subjective norm and perceived behavioral control lead to greater intention to perform that behavior. *Attitudes* refer to the degree in which people favorably or unfavorably evaluate the specific behavior. *Subjective norm* refers to the perceived social pressure to perform that behavior. Finally, *perceived behavioral control* refers to the perceived ease or difficulty of performing the behavior and is assumed to reflect past experience as well as anticipated obstacles. It is important to emphasize that perceived behavioral control may not always correspond with the actual behavioral control because a person can perceive certain behavior to be more or less feasible than it actually is.

A meta-analysis of 185 studies showed that components of TPB on average had accounted for 39% of the variance in intention and 27% of the variance in behavior (Armitage & Conner, 2001). Considering the components separately, perceived behavioral control was most strongly associated with behavioral intention (r=.43). This component itself, while controlling for the subjective norm and attitudes, on average explained 6% of the variance in intention. Subjective norm was the least strongly associated with behavioral intention (r=.34), which is mainly attributed to the inaccuracies of the component's measurement in different studies. Subjective norm was often measured with only one item.

In order to predict the use of environmentally friendly modes of transport (public transport, bicycle, walking), Haustein and Hunecke (2007) extended TPB by introducing a new predictor, *perceived mobility necessity*, described as a mental representation of the relationship between everyday life's demands and the availability of the local transport infrastructure. Using structural equation modeling, the authors showed that subjective norm, attitudes and perceived behavioral control accounted for 85% of the variance in intention to use environmentally friendly modes of transport. Each of these predictors had a significant effect on intention, with the exception of the attitude toward bicycle use. Additionally, perceived behavioral control and intention explained 38% of the variance in actual behavior. The difference in the percentage between explained variance in behavioral intention and in the behavior itself indicates a better predictive power of TPB when it is used to predict intention. Ajzen (1991) points out that the correlation between intention to perform a behavior and its actual performance depends on the controllability of that behavior. It is possible that the use of environmentally friendly modes of transport depends on a number of factors that cannot be controlled by an individual (e.g. infrastructure, distance, weather conditions). This assumption is in line with the

results of the previously mentioned research from Haustein and Hunecke (2007), where perceived behavioral control was the best predictor of using environmentally friendly modes of transport.

Heinen and colleagues (2011) predicted commuter cycling intention separately for three distance categories: less than 5 km, 5 to 10 km and more than 10 km. The concept of habit was added to the usual components of TPB in prediction. *Habit* represented likelihood to use various modes of transport in ten everyday situations (e.g. visiting friends, shopping). Additionally, they used a range of statements reflecting attitudes toward commuting by bicycle that formed three factors: direct trip-based benefit, awareness and safety. Components of TPB, with the addition of habit, explained 35 to 56% of the variance in the intention to commute by bicycle, depending on the distance category. Habit, perceived behavioral control and direct trip-based benefits were significant predictors in all the distance categories, while subjective norm and awareness only in some.

A common complaint regarding TPB refers to the relationship of the intentions, past and current behavior. According to some researchers, frequency of the past behavior (habit) accounts for the variance in later behavior even more than the intention of the same behavior (Ajzen, 2002). However, Ajzen argues that the frequency of past behavior only indicates the stability of the behavior over time, but it does not explain why it is performed. According to the same author, there is no reason to call into question the predictive power of intention only because the behavior is stable over time.

The studies have shown that, although habits are efficient in various cases, in a new context the behavior changes according to the new information about the best option (Davidov, 2007). Bamberg, Ajzen, and Schmidt (2003) conducted a longitudinal study that examined the impact of an intervention – the researchers offered a pre-paid bus ticket and observed how it would alter bus use among students. Their results showed significant changes after the intervention: attitudes towards bus use were more positive, perceived behavioral control higher, subjective norm more emphasized and the actual bus use more frequent. It seems that even when the behavior is a routine - it involves a certain level of cognitive effort. Almost always, there is a possibility that something might prevent the behavior to take place routinely, so it can be concluded that the habit contributes to the prediction of later behavior only when all relevant factors remain stable.

The Role of Personal Norms in Predicting Commuting by Bicycle

Schwartz' norm-activation theory (Schwartz, 1973) was developed with the intention to explain altruistic behavior and includes individual's value orientation as well as personal norms in predicting behavior. According to this theory, normative self-expectations experienced as a sense of obligation (*personal norm*) precede

altruistic behavior. Personal norms are activated as the result of examining behavior consequences and beliefs about personal responsibility.

Ajzen (1991) himself originally stated that, in addition to the components of the TPB, in order to better predict behavioral intention it is useful to include the component of personal norms for some behaviors. To elaborate on this recommendation the author describes research about students cheating on a test or exam, shoplifting and lying to get out of taking a test or turning in an assignment on time (Beck & Ajzen, 1991). Since these are unethical behaviors it was reasonable to consider personal norms and values. Accordingly, the authors included perceived moral obligation along with the usual components of TPB to predict the intention of refraining from the researched unethical behaviors. Although usual components of TPB significantly predicted intention, including perceived moral obligation as a predictor in the analysis further increased the percentage of explained variance for significant 3 to 7%, depending on the behavior. Wall, Devine-Wright, and Mill (2008) also found personal norms to be a good predictor of behavioral intention. While taking into account TPB and norm-activation theory components, the authors showed that the intention to reduce car use is best predicted by perceived behavioral control and personal norms.

Bamberg and Schmidt (2003) argue that the subjective norm as a concept is too simplified because it relies only on social pressure and does not take into account internalized norms and expectations of how one should behave. The decision to use a bicycle may not always be fully rational. In numerous occasions cycling truly is not the most practical choice: it leads to sweating and requires informal clothes, also distances may be great and weather unpredictable. Therefore, it is possible that for this behavior are more relevant some personal values in terms of environmental awareness and a sense of moral obligation to act in accordance with them.

To sum up, TPB offers a good framework for predicting mobility behavior and is open for the inclusion of new predictors to increase its predictive power (Haustein & Hunecke, 2007). The main goal of this study was to test the usefulness of the theory of planned behavior with the addition of personal norm in predicting the intention of bicycle use as a mode of transport to university among students in Zagreb, Croatia. Additionally, the goal of this study was to describe habits of commuting by bicycle while taking into account participants' socioeconomic background as well as characteristics of their commute and accessibility of different transport modes.

Method

Participants

The data were originally obtained from 758 participants. One of the conditions for the adequate implementation of TPB is specific context and situation in which certain behavior is expected to be performed, so the number of potential situations in which the bicycle can be used was narrowed down to the commute to the university. For the purpose of being able to clearly interpret the results it was important that the participants can focus on a specific travelling route and context of bicycle commuting, so 46 participants were excluded from the analysis because they either do not live in Zagreb, are not students or are graduate students which are not obligated to regularly commute to the university. Finally, data for a total of 712 participants living and studying in Zagreb were analyzed. Out of those participants 76% (540) were female, 24% (170) were male and two participants chose the option "something else". Participants' average age was 22 years and 4 months (ranging from 18 to 38 years; *SD*=2.31). Most participants (61%) said that they had a functioning bicycle, while 39% said they did not own a bicycle. Furthermore, 68% did not have the option to use a car for daily commute to the university, 10% had this option and the rest had the option of car use sometimes (22%). Almost half (41%) of the participants had a pre-paid public transport ticket for trams and buses.

Procedure

We conducted an online survey over a period of one month in spring 2013. Invitations were sent via e-mail to conveniently chosen student groups and posted on Facebook pages of student groups and cyclists' organizations like "Sindikat biciklista" [Cyclists' Union], "Zelena akcija" [Green Action] and "Biciklopopravljaona" [Community bike shop]. Additionally, a Facebook event called "(Not) Commuting by bicycle to university" was created with a link to the survey and the description of the research in which Facebook users were asked to participate in the survey and to invite their friends to do the same. The invitation emphasized that it was not important how often a person rides a bicycle or if they ride it at all in order to participate in the study. Participants voluntary and anonymously completed the survey.

Instruments

For the purpose of this study, a questionnaire was created containing three thematic areas: demographics, habits of bicycle use and measures of components of TPB and personal norm. All reported indicators of metric characteristics relate to the data from this study.

The demographic section contained questions about age, sex, place of residence, field of study, year of study, whether the participants had an option to use a car (*yes, no, sometimes*), if they owned a functioning bicycle (*yes, no*) for transport to university and lastly did they have a pre-paid public transport ticket *(yes, no*). Also, participants were asked to estimate the distance between their home and university (*2 km, 2-5 km, 5-10 km* and *more than 10 km*).

The habits of using different modes of transport to university were examined with a total of four items in which participants were asked to estimate the frequency of using a car, bicycle, public transport and walking on a five-point scale ranging from 1 (*never*) to 5 (*almost always*).

The components of TPB were measured with a total of 17 items that were created based on the previous studies (Haustein & Hunecke, 2007; Heinen et al., 2011; Wall et al., 2008). Participants had to estimate their agreement for each item on a Likert-type scale (from 1 *strongly disagree* to 5 *strongly agree*).

The subjective norm was measured according to four items (e.g. *Most people who are important to me think I should use a bicycle for transport to university*; α=.72). Perceived behavioral control was measured according to three items (e.g. *For me, using a bicycle instead of other modes of transport to the university would be hardly feasible.*, α=.64). Attitude towards commuting by bicycle to university was examined according to four items (e.g. *Using a bicycle for transport to university is comfortable.*, α=.85). Finally, the personal norm was measured according to four items (e.g. *I feel it's my responsibility to commute by bicycle to university*., α=.64). Exploratory factor analysis using principal components showed that all TPB components are one-dimensional as expected, except subjective norm. One of the items planned for measuring that component (*Most people who are important to me are not interested in which mode of transport I use to go to university*.) had low correlations with other items (from r=-.06 to r=.10) and low saturation with the dominant factor, and it also undermined the internal scale consistency (Cronbach's alpha was .55 with that criteria included, and .72 without it). Because of the aforementioned reasons this item was excluded from the subjective norm measure which resulted in a clear one-dimensional structure of this measure. Although reliability coefficients for the scales measuring perceived behavioral control and personal norms were below the common standard accepted level of .70 (Nunnally & Bernstein, 1994), we decided to keep the scales due to their logically interpretable and stable factor structure. The overall result for each TPB component was formed as an average on the corresponding criteria.

The criterion variable, the intention of commuting by bicycle to university, was measured according to two items: *I intend to use a bicycle for transport to university in the future; Next time I go to university, I intend to use a bicycle*. Correlation between those two items was .71 (p<.001). The result on the criterion variable of intention was formed as an average on these two items.

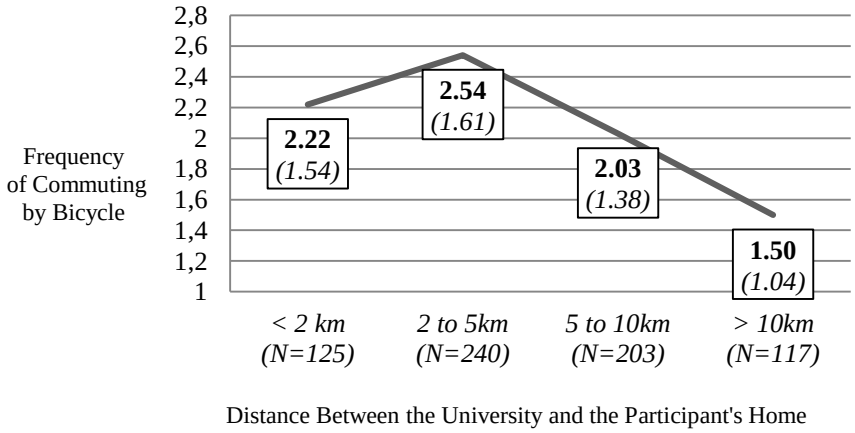
Results

The results of the present study were analysed using statistical software package SPSS (Statistical Package for Social Sciences, SPSS Inc.), version 18.0. Differences in frequency of commuting by bicycle to university between different groups of participants were analysed by independent-samples *t*-test (groups based on participants' sex and accessibility of different transport modes) and the analyses of variance (*ANOVA*) and Scheffé`s post hoc tests (groups based on the distance between participant's home and university). In order to verify the use of TPB components and personal norm in predicting the intention of commuting by bicycle, we conducted a hierarchical regression analysis.

Habits of Commuting by Bicycle to University

The analysis of the frequency of using different modes of transport showed that students in Zagreb most often use public transport to go to university (*M*=3.59, *SD*=1.47). Commuting by bicycle (*M*=2.15, *SD*=1.48) and walking (*M*=2.13, *SD*=1.40) were the second most common choices. Finally, participants reported using a car as the least frequent mode of transport to university (*M*=1.53, *SD*=0.90). The difference in frequency of bicycle use between male and female participants was not statistically significant ($t_{(708)}$=-1.76; *p*=.08), although there was a mild tendency of male participants to report more commuting by bicycle (*M*=2.32, *SD*=1.52) in comparison to females (*M*=2.09, *SD*=1.47).

Figure 1. *Frequency of Commuting by Bicycle with Regard to Distance Between the University and Participant's Home*



Note. The average frequency of bicycle use and standard deviation in parenthesis are indicated for every distance category

As it was expected, the relation between the frequency of bicycle use and the distance between the university and participant's home was not linear (Figure 1). This distribution could be better described as inverted "U" curve with a shift towards lower values. It shows that participants were most likely to commute by bicycle when the distance between their home and university was up to 5 km. The differences between distance categories in the frequency of bicycle use were statistically significant ($F_{(3, 708)}$=14.44; p<.001). Results of the post hoc analysis showed that the frequency of bicycle use was significantly lower for participants who lived more than 10 km away from university than those who lived at smaller distances (Cohen's $d_{(>10km\ vs.\ <2km)}$=.56; Cohen's $d_{(>10km\ vs.\ 2\text{-}5km)}$=.78; Cohen's $d_{(>10km\ vs.\ 5\text{-}10km)}$=.44). Also, results showed that those who lived at 2 to 5 km were significantly more likely to use a bicycle in comparison to those who live at 5 to 10 km from university (Cohen's $d_{(2\text{-}5km\ vs.\ 5\text{-}10km)}$=.34).

Table 1. *Frequency of Commuting by Bicycle with Regard to the Option of Car Use, Having a Functioning Bicycle and Pre-Paid Public Transport Ticket*

		Commuting by Bicycle		
		N(%)	*M*	*SD*
The Option of Car Use	Yes/sometimes	231 (32.44)	2.22	1.49
	No	481 (67.56)	2.11	1.48
Having a Functioning Bicycle	Yes	436 (61.24)	2.83	1.53
	No	276 (38.76)	1.07	0.29
Having a Pre-Paid Public Transport Ticket	Yes	293 (41.15)	1.70	1.16
	No	419 (58.85)	2.46	1.60

Note. Due to small number of participants, the data from the response categories *yes* (*N*=69) and *sometimes* (*N*=162) for the variable *The option of car use* was combined.

Descriptive data on the frequency of commuting by bicycle with regard to the option of car use, having a functioning bicycle, and pre-paid public transport ticket are shown in Table 1. We checked if there were statistically significant differences in the frequency of commuting by bicycle with regard to the aforementioned categories of accessibility of different transport modes. There was no statistically significant difference in the frequency of bicycle use between those who owned and sometimes had the option of using a car in comparison to those who did not have that option ($t_{(710)}$=0.93, p=.35). As expected, those participants who had a functioning bicycle reported more frequent bicycle use as a mode of transport to university than those who did not ($t_{(484, 375)}$=23.32, p<.001). Also, there was a statistically significant difference in the frequency of bicycle use among the participants who had a pre-paid public transport ticket - they reported lower frequencies of commuter cycling to university ($t_{(709, 282)}$=-7.33, p<.001).

Applying TPB in Predicting Commuting by Bicycle to University

The intercorrelations of the predictors (TPB components and personal norm), and the criterion (the intention of commuting by bicycle to university) are shown in Table 2. All of the planned predictors significantly correlated with the intention of commuting by bicycle at a significance level of 0.1%, with the attitude toward bicycle use being the most strongly (r=.66) and personal norm being least strongly correlated to the intention (r=.44).

Table 2. *Intercorrelations of TPB Components and Personal Norm (Predictors), and the Intention of Commuting by Bicycle to University (Criterion) (N=712)*

	Subjective Norm	Perceived Behavioral Control	Attitude Toward Bicycle Use	Personal Norm
Intention of Commuting by Bicycle	.57***	.64***	.66***	.44***
Subjective Norm	-	.47***	.51***	.41***
Perceived Behavioral Control		-	.68***	.27***
Attitude Toward Bicycle Use			-	.35***

*** p<.001.

Results of the hierarchical regression analysis showed that in the first step, using only TPB components, subjective norm, perceived behavioral control, and attitude toward bicycle use we explained 55.3% (F=294.77, p<.001; Table 3) of the variance in intention of commuting by bicycle. All of the used predictors significantly contributed to predicting the intention, with attitude toward bicycle use being the best predictor (β=.34), followed by perceived behavioral control (β=.29) and subjective norm (β=.26). Adding personal norm in the second step of the analysis explained an additional 2.3% of the variance in the intention of commuting by bicycle. This increase in explained variance was statistically significant ($F_{change(1,\ 707)}$=37.72, p<.001). All of the used predictors remained statistically significant at the significance level of 0.1%. The best predictor was still the attitude toward bicycle use (β=.30), followed by perceived behavioral control (β=.29) and subjective norm (β=.21), while the personal norm was the weakest predictor of intention (β=.17).

Table 3. *Hierarchical Regression Analysis for TPB Components and Personal Norm as Predictors of the Intention of Commuting by Bicycle to University (N=712)*

	Intention of commuting by bicycle to university		
Predictors	R^2	ΔR^2	β
1. Step	.56***	.56***	
Subjective Norm			.26***
Perceived Behavioral Control			.29***
Attitude Toward Bicycle Use			.34***
			F=294.77***
2. Step	.58***	.02	
Personal Norm			.17***
			F=37.72***

***p<.001.

Discussion

Habits of Commuting by Bicycle to University

The results of the present study show that students in Zagreb mostly use public transport to go to university. Commuting by bicycle is the second most common choice, with around 34% of students using a bicycle for this purpose at least half of the time. Taking into account our results, along with PRESTO's (2011) findings that less than three percent of all daily trips in Zagreb are done by bicycle, we can assume that students are probably the most frequent bicycle users in Zagreb. Although, it should be noted that the observed frequency of bicycle use might be higher than it was with general student population due to the specificity of the sampling method. We used the method of "snowball sampling" where the dissemination of the questionnaire was to a considerable extent directed towards organizations related to cycling. Students walk to university almost as often as they commute by bicycle. To sum up, it seems that students prefer environmentally friendly modes of transport, but at the same time it is possible that students opt for public transport, bicycle or walking simply because they are not able to use a car. Only 10% of them always had that option and another 22% sometimes.

Usually in countries with high cycling mode share, such as Belgium or the Netherlands, there are no gender differences in the frequency of bicycle use, while in countries where the bicycle is generally used less, men cycle more often (Garrard et al., 2008). Surprisingly, the results of this study showed that male and female students in Zagreb use a bicycle as a mode of transport to university equally often. According to PRESTO's report (2011) Croatia definitely does not fall into the category of countries with high bicycle transport mode share, so we believe this finding mostly occurred because of the already mentioned sample characteristics.

Moreover, in our final sample there were far less male students (N_m=170) in comparison to female students (N_f=540).

The frequency of bicycle use differed with regard to the distance between the university and participant's home. Heinen and colleagues (2011) have shown that the relationship between frequency of commuter cycling and cycling distance is not linear. Rather, it could be better described as inverted "U" curve. In their research bicycle use was the least frequent at the shortest (less than 5 km) and the longest distances (more than 10 km), while it was the most frequent at medium distances. The results of our research, to a certain extent, follow the inverted "U" curve. The frequency of bicycle use first increased with distance and stopped at the distance category of 2 to 5 km when it started to decrease and was smallest at distances longer than 10 km. In other words, our participants most frequently used bicycles at distances much shorter than those in the Heinen's study. A number of factors, from those related to the physical environment to social ones, strongly encourage cycling in the Netherlands as opposed to Croatia, so in Zagreb more frequent cycling is expected at shorter distances.

An interesting finding was that there was no statistically significant difference in the frequency of bicycle use between those who sometimes had and those who did not have the option of using a car. Results from previous studies have shown that in comparison to those who did not have the option to use a car, people who had that option use a bicycle less frequently (Sissons Joshi & Senior, 1998). It is reasonable to assume that students do not use a car for daily activities such as going to university because they cannot finance regular expenses of car use (fuel, parking, etc.), so they do not use it for this purpose even when they have the opportunity to do so.

Applying TPB in Predicting Commuting by Bicycle to University

All TPB components taken together explained 55% of the variance of the intention of commuting by bicycle to university. This finding is in line with past research that shows strong predictive power of TPB components in predicting intention to use different modes of transport (e.g. Bamberg & Schmidt, 2003; Haustein & Hunecke, 2007; Heinen et al., 2010).

As it was expected, all TPB components were significant predictors, but unexpectedly the attitude toward bicycle use was the strongest one followed by perceived behavioral control (Table 3). In many of the previous studies perceived behavioral control was the dominant predictor (e.g. Haustein & Hunecke, 2007; Wall, Devine-Wright, & Mill, 2007). This discrepancy can be best understood by looking into research findings on the multidimensionality of these two TPB components. Kraft, Rise, Sutton, and Roysamb (2005), while using TPB in predicting intention to exercise and recycle, presented results that call into attention the complexity of attitudes and perceived behavioral control. These authors suggest that perceived behavioral control could be described by two different patterns of

separate but interrelated factors - either as consisting of three factors: perceived control, perceived confidence and perceived difficulty; or as consisting of two factors: perceived control and self-efficacy (measured by perceived difficulty and perceived confidence). In the same article, the authors obtained a stable two-factor solution for the attitudes component. One factor represented instrumental attitudes and referred to the attitudes towards consequences of certain behavior (e.g. to what extent the behavior is useful or harmful, good or bad). The other factor represented affective attitudes and referred to how much the behavior is perceived as being boring or interesting, stressful or relaxing, pleasant or unpleasant. According to the results of Kraft and colleagues, only the affective attitudes significantly correlated to the components of perceived behavioral control. Additionally, affective attitudes were significantly better predictors of behavioral intentions for both exercising and recycling (β=.33 and β=.39, respectively) in comparison to the instrumental ones (β=.07 and β=.17, respectively). The authors point out the possibility that in previous studies the predictive power of perceived behavioral control was overestimated because one of its dimensions (perceived difficulty) is closely related to the affective component of attitudes. On the other hand, while explaining the underestimated predictive power of attitudes they stress the problem of measuring issues. Attitudes are often operationalized as instrumental ones while the affective component that was proven to be more predictive for behavioral intention is frequently overlooked. Ajzen and Driver (1991) also obtained a two-dimensional structure of the attitude component while using TPB in predicting the intention of participation in various leisure activities. Although both instrumental and affective attitudes were significant predictors of behavioral intention, their predictive power depended on the type of behavior. For example, instrumental attitudes were better predictors for the intention of running and hiking while affective ones for the intention of spending time on the beach, cycling and rowing. A closer inspection of the correlation between predictors observed in our study shows that the correlation between perceived behavioral control and attitudes is the largest one (r=.68; Table 2). This finding is in accordance with Kraft and colleagues (2005) and supports the claim that attitudes and perceived behavioral control conceptually overlap to some extent. The content of items used in this study to measure attitudes towards bicycle use refers mostly to the affective component and can explain the primary role of attitudes in predicting the intention of commuting by bicycle to university. In order to yield more useful and meaningful results in predicting behavioral intention, greater methodological and conceptual clarity is needed in measuring attitudes. It would be important, in future studies, to differentiate between the instrumental and the affective aspect of attitude component of TPB as well as examine the dimensionality of perceived behavioral control.

Subjective norm was the weakest predictor for the behavioral intention of all TPB components. This finding is consistent with the results of previous studies where the intention for different behaviors was predicted (Ajzen, 1991; Heinen et al., 2010). Commuting by bicycle to university is a behavior that requires great personal investment (bicycle purchase, physical effort while cycling, etc.), so it is reasonable

that personal attitudes about that behavior and the beliefs about one's ability to perform that behavior are more important in deciding to use a bicycle as a mode of transport than support from one's social surroundings.

Finally, adding personal norms to the components of TPB significantly contributed to explaining behavioral intention, but it was the weakest predictor. This finding indicates that the feeling of personal responsibility to act towards reducing motorized transport and the accordance of bicycle use with general personal values and principles is to some extent important for the intention to use a bicycle as a mode of transport. At the same time, the bicycle is just one of the environmentally friendly modes of transport, along with walking and using public transport. Thus, it is possible that the personal norm would be a stronger predictor if we tried to predict the use of more environmentally friendly modes of transport. An individual can feel a strong personal responsibility to contribute to reducing motorized transport by selecting environmentally friendly modes, but instead of choosing to use a bicycle one could choose walking or public transport.

Limitations and Methodological Considerations

Several limitations apply to the present research. Although the survey sample covered a large number of students in the city of Zagreb, generalization of the present findings is somewhat compromised due to the snowball sampling and, accordingly, lack of heterogeneity with respect to gender and field of study. Around three-quarters of participants were female students. Also, more than half of the participants studied social science or humanities (35% of them studied at the Faculty of Humanities and Social Sciences, 14% at the Centre for Croatian Studies and 13% at the Faculty of Political Science). Additional studies using larger and more representative samples may provide more detailed information and an opportunity for comparisons between groups.

Considering the theoretical basis of this study, it is relevant to mention the ambiguous relation between intention and behavior within TPB. Components of this theory originally predict the intention of a certain behavior and not the behavior itself. In other words, even when there is intention it is still questionable whether the behavior will occur. However, research shows that the intention is a good predictor of behavior. Schwenk and Moser's (2009) meta-analysis of studies about environmentally friendly behaviors (e.g., recycling, selection of modes of transport) showed an average correlation of .54 between behavior and intention. Also with regard to conceptual issues of TPB, the results of previous as well as the present research highlight the importance of taking into account the multidimensionality of certain theory components in future research, specifically attitudes and perceived behavioral control. In our research, all measures of the components of TPB were one-dimensional, but the reliability of the scales measuring perceived behavioral control and personal norms was lower (α=.64; for both scales). Lower reliability of the scales

used in this research could partly be the result of their length (perceived behavioral control scale contains three and personal norms scale four items). We applied the Spearman-Brown prediction formula (Nunnally & Bernstein, 1994) to predict the necessary length of the test in order to attain acceptable reliability. Results showed that the acceptable reliability (α=.70) of these scales could be attained by adding one more item and good reliability (α=.80) by doubling the number of scale items. Low reliability of the predictors in multiple regression analysis can lead to erroneous findings, for example increased possibility of Type II errors for the variables with lower reliability and Type I errors for the rest of the variables in the model (Osborne & Waters, 2002). Therefore, we would suggest designing more comprehensive and reliable scales for the components of TPB in future research by expanding the length of the scales and considering components' multidimensionality.

Conclusions and Implications of Study Results

Listed limitations notwithstanding, our findings have provided confirmation of the usefulness of the TPB components, with the addition of personal norms, for predicting the intention of commuting by bicycle to university. Reducing motorized modes of transport has a number of positive effects on the environment, utilization of urban space, human health and quality of life. Studies that provide better understanding of factors relevant to the choice of transport modes can help in creating campaigns that will encourage bicycle use as a mode of transport. Our results highlight the value of attitudes as predictors of bicycle use. This finding is very important considering that changing attitude is much simpler than altering the environment or influencing perceived behavioral control. Such measures to increase bicycle use largely depend on external factors as existing infrastructure, while attitudes provide a more straightforward way to increase bicycle use. Continuous promotion of the bicycle as a practical, environmentally friendly, cheap, and healthy mode of transport might work towards creating more positive attitudes that could contribute to stronger intention and more frequent bicycle use.

References

Ajzen, I. (1991). The Theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50,* 179-211.

Ajzen, I. (2002). Residual effects of past on later behavior: Habituation and reasoned action perspectives. *Personality and Social Psychology Review, 6*(2), 107-122.

Ajzen, I., & Driver, B.L. (1991). Prediction of leisure participation from behavioral, normative and control beliefs: An application of the theory of planned bahaviour. *Leisure Sciences, 13*, 185-204.

Akar, G., & Clifton, K.J. (2009). Influence of individual perceptions and bicycle infrastructure on decision to bike. *Transportation Research Record: Journal of the Transportation Research Board, 2140*(1), 165-172.

Armitage, C.J., & Conner, M. (2001). Efficacy of the Theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*, 471-499.

Bamberg, S., Ajzen, I., & Schmidt, P. (2003). Choice of travel mode in the Theory of planned behavior: The roles of past behavior, habit, and reasoned action. *Basic and Applied Social Psychology, 25*(3), 175-187.

Bamberg, S., & Schmidt, P. (2003). Incentives, morality, or habit? Predicting students' car use for faculty routes with the models of Ajzen, Schwartz, and Triandis. *Environment and Behavior, 35*(2), 264-285.

Beck, L., & Ajzen, I. (1991). Predicting dishonest actions using the Theory of planned behavior. *Journal of Research in Personality, 25,* 285-301.

Davidov, E. (2007). Explaining habits in a new context the case of travel-mode choice. *Rationality and Society, 19*(3), 315-334.

De Geus, B., De Bourdeaudhuij, I., Jannes, C., & Meeusen, R. (2008). Psychosocial and environmental factors associated with cycling for transport among a working population. *Health Education Research, 23*(4), 697-708.

Engbers, L.H., & Hendriksen, I.J.M. (2010). Characteristics of a population of commuter cyclists in the Netherlands: Perceived barriers and facilitators in the personal, social and physical environment. *International Journal of Behavioral Nutrition and Physical Activity, 7*(1), 89-95.

Freund, P., & Martin, G. (2007). Hyperautomobility, the social organisation of space, and health. *Mobilities, 2*(1), 37-49.

Garrard, J., Rose, G., & Lo, S.K. (2008). Promoting transportation cycling for women: The role of bicycle infrastructure. *Preventive Medicine, 46*(1), 55-59.

Goetzke, F., & Rave, T. (2011). Bicycle use in Germany: Explaining differences between municipalities with social network effects. *Urban Studies, 48*(2), 427-437.

Haustein, S., & Hunecke, M. (2007). Reduced use of environmentally friendly modes of transportation caused by percived mobility necessities: An extension of the Theory of planned behavior. *Journal of Applied Social Psychology, 37*(8), 1856-1883.

Heinen, E., Maat, K., & Van Wee, B. (2011). The role of attitudes toward the characteristics of bicycle commuting on the choice to cycle to work at various distances. *Transportation Research, 16*(2), 102-109.

Heinen, E., Van Wee, B., & Maat, K. (2010). Commuting by bicycle: An overview of the literature. *Transport Reviews, 30*(1), 59-96.

Kraft, P., Rise, J., Sutton, S., & Rosysamb, E. (2005). Perceived difficulty in the Theory of planned behavior: Perceived behavioral control or affective attitude?. *British Journal of Social Psychology, 44,* 479-496.

Lukić, A., Prelogović, V., & Rihtar, S. (2011). Planning a more humane city: Student expectations concerning bicycle use and transportation in Zagreb. *Hrvatski geografski glasnik*, *73*(1), 111-132.

McCarthy, D. (2011). 'I'm a normal person': An examination of how utilitarian cyclists in Charleston South Carolina use an insider/outsider framework to make sense of risks. *Urban Studies*, *48*(7), 1439 - 1455.

Nunnally, J.C., & Bernstein, I.H. (1994). *Psychometric theory* (3rd ed). New York: McGraw-Hill.

Osborne, J.W., & Waters, E. (2002). Four assumptions of multiple regression that researchers should always test. *Practical Assessment, Research & Evaluation*, *8*(2), 1-9.

PRESTO (2011). Promocija vožnje biciklom kao načina dnevnog prijevoza za svakoga – lekcije naučene u pet vrlo različitih gradova. [Promoting cycling for everyone as a daily transport mode – lessons learnt in five very different cities.] *Intelligent Energy Europe.*

Pucher, J., Dill, J., & Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: An international review. *Preventive Medicine*, *50*, 106-125.

Schwartz, S.H. (1973). Normative explanations of helping behavior: A critique, proposal, and empirical test. *Journal of Experimental Social Psychology*, *9*, 349-364.

Schwenk, G., & Möser, G. (2009). Intention and behavior: A Bayesian meta-analysis with focus on the Ajzen-Fishbein model in the field of environmental behavior. *Quality & Quantity*, *43*, 743-755.

Sissons Joshi, M., & Senior, V. (1998). Journey to work: The potential for modal shift? *Health Education Journal*, *57*, 212-223.

Steg, L. (2005). Car use: Lust and must. Instrumental, symbolic and affective motives for car use. *Transportation Research Part A*, *39*, 147-162.

Wall, R., Devine-Wright, P., & Mill, G.A. (2007). Comparing and combining theories to explain proenvironmental intentions: The case of commuting-mode choice. *Environment and Behavior*, *39*(6), 731-735.

Wall, R., Devine-Wright, P., & Mill, G.A. (2008). Interactions between perceived behavioral control and personal-normative motives: Qualitative and quantitative evidence from a study of commuting-mode choice. *Journal of Mixed Methods Research, 2*(1), 63-86.

Willis, D., Manaugh, K., & El-Geneidy, A. (2013). *Cycling under influence: Summarizing the influence of attitudes, habits, social environments and perceptions on cycling for transportation*. Paper accepted for presentation at the *92nd* Transportation Research Board Annual Meeting, Washington D.C., USA.

Biciklirati ili ne? Primjena Teorije planiranog ponašanja u predviđanju učestalosti korištenja bicikla među studentima u Zagrebu

Sažetak

Smanjeno bi korištenje motoriziranih prijevoznih sredstava imalo brojne pozitivne efekte na okoliš i kvalitetu života općenito. Istraživanja koja će osigurati bolje razumijevanje onih faktora koji utječu na izbor prijevoznog sredstva mogu pomoći pri kreiranju kampanja kojima će se ljude poticati na korištenje ekološki prihvatljivijih oblika prijevoza. Glavni je cilj istraživanja provedenog među studentima u Zagrebu bio ispitati primjenjivost Teorije planiranog ponašanja (TPP), uz osobnu normu, za predviđanje učestalosti korištenja bicikla kao osnovnoga prijevoznog sredstva za dolazak na fakultet. U istraživanju je sudjelovalo 712 studenata Sveučilišta u Zagrebu, koji su ispunili upitnik *on line*. Prema rezultatima istraživanja studenti za dolazak na fakultete najčešće koriste sredstva javnoga prijevoza, dok je bicikl drugo najčešće korišteno prijevozno sredstvo. Učestalost korištenja bicikla ovisi o udaljenosti između mjesta stanovanja i fakulteta. Kako se povećava udaljenost između mjesta stanovanja i fakulteta, tako raste učestalost korištenja bicikla, do određene udaljenosti. Kod udaljenosti od 2 do 5 km dolazi do pada u učestalosti korištenja bicikla kao osnovnoga prijevoznog sredstva za dolazak na fakultet. Bicikl se najrjeđe koristi kada udaljenost iznosi više od 10 km. Sve su se komponente teorije TPP pokazale značajnim prediktorima i objašnjavaju 55% varijance u namjeri korištenja bicikla kao prijevoznog sredstva. Dodavanjem osobne norme komponentama teorije TPP dolazi do malog, ali značajnog povećanja objašnjenja varijance (dodatnih 2%), međutim osobna norma bila je najlošiji prediktor. U radu se raspravlja o praktičnim i teorijskim implikacijama rezultata.

Ključne riječi: Teorija planiranog ponašanja, osobna norma, vrsta prijevoznog sredstva, bicikl, dnevna migracija

¿Montar en bicicleta o no? Aplicación de la Teoría del Comportamiento Planificado en la predicción del uso de bicicleta entre los estudiantes en Zagreb

Resumen

Menor uso de medios de transporte motorizados tendría numerosos efectos positivos para el medio ambiente y la calidad de vida en general. Las investigaciones que asegurarán mejor comprensión de aquellos factores que influyen en la selección del medio de transporte pueden ayudar en creación de las campañas que estimularán a la gente para usar un transporte más aceptable ecológicamente. El principal objetivo de la investigación fue investigar la aplicabilidad de la Teoría del Comportamiento Planificado, con ciertas normas personales, para la predicción de la frecuencia del uso de bicicleta como el principal medio de transporte para ir a la facultad, entre los estudiantes en Zagreb. En la investigación participaron 712 estudiantes de la Universidad de Zagreb que rellenaron un cuestionario en la red. Según los resultados de la investigación, los estudiantes para ir a la facultad normalmente usan el transporte público, mientras que la bicicleta es el segundo medio de transporte más usado. La frecuencia del uso de bicicleta depende de la distancia entre el lugar de residencia y la facultad. El uso de bicicleta aumenta hasta una cierta distancia. En la distancia entre 2 y 5 kilómetros el uso de bicicleta como el principal medio de transporte para ir a la facultad disminuye. El menor uso de la bicicleta se nota cuando la distancia es mayor de 10 kilómetros. Todos los componentes de la Teoría del Comportamiento Planificado se mostraron como predictores significativos y explican el 55% de la varianza en la intención del uso de bicicleta como medio de transporte. Añadiendo las normas personales a los componentes de la Teoría del Comportamiento Planificado se nota un aumento pequeño, pero significativo en la explicación de la varianza (2% adicionales), pero la norma personal fue el peor predictor. En el artículo se discuten las implicaciones prácticas y teóricas del resultado.

Palabras claves: Teoría del Comportamiento Planificado, norma personal, tipo del medio de transporte, bicicleta, migración diaria

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