

DETERMINANTS OF BICYCLE USE INTENTION FOR DAILY COMMUTING: AN EXTENDED THEORY OF PLANNED BEHAVIOR APPROACH

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Abstract

The use of bicycles for daily commutes plays a key role in promoting sustainable urban transportation. The intention to use the bicycle is determined by both individual factors and the characteristics of the travel environment. This study investigates the determinants of bicycle use intention by extending the Theory of Planned Behavior (TPB) by three additional dimensions: perception of environmental benefits, cycling infrastructure, and traffic safety. The proposed model assesses the direct relationships between classical TPB constructs and intention, as well as the indirect mechanisms by which environmental and contextual factors influence intention through attitude and perceived behavioral control. The data were analyzed using Structural Equation Modeling (SEM). Attitude and perceived behavioral control positively and significantly influence the intention to use the bicycle. The perception of environmental benefits strongly influences attitude, and its effect on intention is significantly mediated by attitude. Infrastructure and safety influence perceived behavioral control and have significant indirect effects on intention. The findings suggest that the relevance of subjective norms is not universal but may vary according to the degree of social pressure, collective orientation, and normative acceptance associated with a particular behavior. In the

Romanian context, bicycle-use intentions is more dependent on personal attitudes and perceived behavioral control than social perspectives. Also, the awareness of the environmental perception does not directly translate into a greater intention to use the bicycle. This may question the role of educational and informational factors in shaping how individuals understand, internalize environmental benefits and action accordingly. The results highlight the need to integrate psychological, educational, environmental, and infrastructural dimensions into policies to promote bicycle mobility.

Keywords: bicycle use intention, theory of planned behavior (TPB), cycling infrastructure, safety, transport sustainability.

1. INTRODUCTION

According to the OECD vision, the bicycle should not only be considered as an alternative means of transport, but as an essential component of a fair, efficient, and sustainable urban system. Promoting cycling contributes to improving accessibility, reducing congestion and pollution, as well as creating more pleasant and safer cities for residents (ITF, 2024). The OECD stresses that the development of bicycle infrastructure should be accompanied by integrated public policies that redistribute urban space in favour of people and reduce dependence on the car. The EU's strategy considers that cycling integration must be achieved through Sustainable Urban Mobility Plans, which coordinate infrastructure, public transport, and urban development policies. The strategy aims to reduce greenhouse gas emissions, air pollution and noise and supports the objectives of the European Green Deal and climate neutrality by 2050 (Rupprecht Consult, 2025). At the same time, cycling is considered efficient, accessible, and beneficial for the health, social inclusion, and economic vitality of cities. The guidelines recommends building continuous and safe networks of paths, bicycle parking facilities, bike-sharing systems and connecting cycling with public transport. An important aspect is the social inclusiveness; thus, policies must respond to the needs of various categories of users and make cycling accessible to all social groups (Rupprecht Consult, 2026). Therefore, both OECD and EU visions combine environmental, social, and economic objectives, promoting cleaner, safer, healthier, and more accessible cities.

European cities have developed three types of cycling development strategies over time (Colli, Küster & Žganec, 2022):

- The model of infrastructure consolidation is applied in the Netherlands and nordic countries. In these countries, cycling has been integrated into urban planning and transport policies for several decades. Bicycle infrastructure is, in many situations, physically separated from motorized traffic, and networks are extended and permanently connected. The model is not limited to lanes, but includes a systemic vision based on "Vision Zero" (zero road fatalities) and discouraging car use in urban centers through prohibitive parking fees and the transformation of secondary streets into bicycle-priority areas. Fast bicycle routes play a significant role, as well as parking facilities near train stations and urban centers.

- The model of accelerated urban transformation is specific to France and Belgium. The Vélo Plan 2021–2026 aims to expand the network of safe lanes, increase the number of bicycle parking spaces and introduce two-way traffic on numerous secondary streets. The measures include, in certain areas, the reallocation of space previously occupied by cars. The concept of the "15-minutes city" completes this vision, but refers to the general organisation of urban services, not exclusively cycling.
- The territorial cohesion and multimodality model (Central and Eastern Europe) is specific to the countries that are now developing their national network (e.g., Lithuania, Romania, Hungary). This model is strongly propelled by the conditionalities of the EU structural funds. The main focus is not only urban, but regional, focused on intermodality (bicycle spaces on trains, secure parking at transport hubs) and on the development of cycle tourism through interconnected networks such as EuroVelo.

To analyze how cities are ready for the use of bicycles, the academic literature provides multiple answers. A bikeability index was proposed by Winters et al. (2013) based on the availability of cycling facilities, network connectivity, topography, and land use. Hardinghaus et al. (2021) further advanced this approach by developing multifactorial indices whose criteria were weighted according to expert survey. Quintero-Gomez & Calvo-Bascones (2026) introduces the BIKE Index, a multi-dimensional and reproducible framework for evaluating urban cycling conditions across cities, developed in response to the lack of standardized tools for assessing bikeability in urban areas. The index integrates four key dimensions into a composite score: Cycling Infrastructure, Cyclist Services, Environmental Constraints, and Safety and Street Quality. The environmental and operational context has gained prominence in the recent years. Factor such as topography, urban form (Kaplan, Nielsen & Prato, 2016; Li, Qin & Xu, 2025), and weather conditions (Lin & Wei, 2018; Zheng et al., 2025) can limit the operational resilience of these systems. The innovative solutions strive to increase intermodality and equity (Fan & Harper, 2024; Liu et al., 2024), safety (Thompson et al., 2018; von Stülpnagel & Lucas, 2020). Bicycle use is also determined by the interaction between socio-demographic characteristics, access to resources, and mobility culture (Rosca et al., 2010; Harms et al., 2014, Kawgan-Kagan, 2020; Reck et al. 2021).

Understanding the factors that determine the use of the bicycle as a mode of transport requires an approach that captures both the psychological processes underlying the individual decision and the external conditions in which it is made. In this context, the Theory of Planned Behavior (TPB) provides an appropriate theoretical framework for explaining the intention to use the bicycle, through the role of attitude towards behavior, subjective norms and perceived behavioral control. The application of TPB in the field of active mobility can be improved by integrating contextual factors that influence the perception and

feasibility of behavior. The present study expands the TPB model by integrating contextual variables associated with bicycle infrastructure and traffic safety, as well as the perception of the environmental benefits of bicycle use. In the proposed model, bicycle infrastructure and traffic safety are considered antecedents of perceived behavioral control, while the perception of environmental benefits is introduced as a mediation mechanism between attitude and behavioral intention. In this regard, the study aims to contribute to filling three research gaps: (i) the integration of contextual and environmental factors into a behavioural framework based on TPB, (ii) clarifying the role of infrastructure and safety as factors shaping perceived behavioural control, and (iii) identifying the mechanism by which the perception of environmental benefits can transform the attitude towards the bicycle into intention to use. Therefore, the proposed model aims to provide a more complete explanation of the intention to use the bicycle, connecting the individual determinants of the behavior with the characteristics of the urban environment in which it occurs.

2. LITERATURE REVIEW

The Theory of Planned Behavior (TPB) model provides a useful framework for understanding the reasons that lead people to choose the bicycle for daily commuting. Unlike an analysis based solely on socio-demographic characteristics or the availability of infrastructure, TPB allows the examination of the psychological process that precedes the behavior. According to the model proposed by Ajzen (1991), a person's intention to use the bicycle is influenced by three main components: attitude, subjective norms, and perceived behavioral control. The attitude reflects how the individual evaluates the use of the bicycle, subjective norms refer to the influence of family, friends and community, while perceived behavioral control expresses the extent to which the person believes that they can use the bicycle realistically. An important advantage of TPB is its flexibility. The model can be extended by including factors such as environmental protection concern, traffic safety perception, and quality of infrastructure. In this way, the analysis is not limited to the question of whether a person intends to use the bicycle, but also explains why this intention does or does not occur. TPB has been used to explain the intention of using bicycle as a transport mode in various cultural contexts and age groups.

Forward (2004) revealed for the Netherlands, Denmark, Sweden and Spain that TPB explains 47-48% of bicycle use intention. The significant predictors are habit and perceived behavioral control, while the subjective norms are significant only for the Netherlands. The study by de Bruijn et al. (2009) in the Netherlands found the perceived behavioral control and habit as significant predictors, while attitude and subjective norms playing insignificant roles. Investigating commuting to university in Zagreb by bicycle, Milkovic and Stambuk (2015) used an TPB extended with personal norms. Attitude towards cycling had the most important influence, followed by perceived behavioural control, subjective norms and personal

norm. These results suggest that the decision to cycle to university is primarily influenced by how people evaluate this behaviour and the extent to which they believe they can effectively achieve it. Personal norm has an additional role, reflecting the individual's sense of responsibility or moral obligation, but its impact is lower than that of the other components of the model. The study by Caballero et al. (2019) in Argentina confirms the usefulness of the TPB model for explaining the intention to use the bicycle on trips to the university. All the three components of the TPB — attitude, subjective norms and perceived behavioral control — explained about 59% of the variation in the intention to use.

The results of the study by Baeli et al. (2022) show that the most important predictor of intention to use a bicycle was the habit of using a bicycle, which suggests that previous experiences and travel routines play a key role in the formation of intention. At a relatively close level of importance were financial incentives and attitude towards bicycle use. These results indicate that the availability of economic benefits, such as subsidies or rewards, can encourage bicycle use, especially when supported by a favorable perception of this mode of transport. In contrast, subjective norms and perceived behavioral control had relatively little importance. Therefore, in the context of the Italian study, the intention to use the bicycle seems to be influenced above all by the behaviors already formed, the financial advantages and the personal evaluation of cycling, rather than by social pressure or the perception of control over the behavior. In Serbia, the study by Djokic et al. (2023) analyzed students' intention to use or buy electric bicycles, integrating the Theory of Planned Behavior (TPB) model with the variable financial incentives. The results showed that financial incentives had the strongest positive and significant influence on the intention to use the electric bicycle. Their effect was considerably greater than that of the other variables analyzed. The attitude towards the electric bicycle and the subjective norms also had positive and significant effects on the intention, but their influence was smaller and relatively close in intensity. In contrast, the perceived behavioral control did not have a statistically significant effect, so the hypothesis associated with this relationship was rejected. The study of Ciocîrlan & Rowe (2025) in UK showed that, in the standard TPB model, subjective norms and perceived behavioral control significantly predicted the intention to walk or cycle, whereas attitude was not a significant predictor. When habit and moral norm were added to the extended model, habit remained a significant predictor of intention, while perceived behavioral control continued to show a strong effect.

The analysis of the studies shows that the intention to use the bicycle is influenced by different factors, and their importance varies depending on the social, cultural and institutional environment in which the research is conducted. These differences justify the usefulness of the proposed study, as they demonstrate that the results obtained in a given country, population category or form of cycling cannot be automatically transferred to another context. By applying an extended TPB model, the study can identify

the factors that influence the intention to use the bicycle in the analyzed environment and can highlight whether personal, social, economic, environmental or infrastructural motivations predominate. Thus, the research can contribute both to the development of the literature and to the formulation of mobility policies adapted to the local reality, such as improving infrastructure, increasing safety, providing incentives or promoting favorable attitudes towards cycling.

3. RESEARCH METHODOLOGY

3.1. *Variables and Questionnaire Design*

An extended TPB questionnaire (Table 1) was developed, including TPB constructs (attitudes, subjective norms, and perceived behavioral control) and extended variables (infrastructure, safety, and environmental concerns). Demographic data (gender, age, income, and education) were also collected.

Attitude (AT) highlights a subject's tendency to appreciate something in a more or less favorable manner. Research on the choice of mode of travel has shown that attitude towards cycling is a determining factor in the formation of the intention to use the bicycle in daily walking (Dill & Voros, 2007; Heinen et al., 2011; Milković & Štambuk, 2015; Caballero et al., 2019, Baeli et al. 2022). Attitudes were measured using four scales: convenience, pleasure of use, evaluating cycling as a travel mode, and overall positive evaluation.

Subjective norms (SN) represent a person's perception of how the people important to him evaluate a certain behavior (Ajzen, 1991). Some studies have shown that subjective norms are the main predictor of intention to ride a bicycle (Forward, 2004; Caballero et al., 2019; Ciocîrlan & Rowe, 2025). Subjective norms were assessed in terms of perceived normative expectations of family, normative expectations of important others, social approval, and social support.

Perceived behavioral control (PBC) represents the personal perception of the ability and ease or difficulty of performing a certain behavior. Numerous studies have highlighted the fact that PBC is an important variable in determining the intention to use the bicycle as a means of transport (Caballero et al., 2019; de Souza et al., 2014; Si et al., 2020; Ciocîrlan & Rowe, 2025). Four scales are used to evaluate PBC: perceived capability, self-efficacy, control over decision, autonomy.

Intention (INT) to perform the target behaviour was measured using three items: behavioral intention, behavioral planning, and intended effort.

Beside the classical TPB variables, bicycle infrastructure, traffic safety, as well as the perception of the environmental benefits are the new latent variables introduced in the extended model. Recent research links infrastructure availability and safety to the intention to use the bicycle. Márquez et al. (2021) have shown that certain characteristics of the lanes influence the intention to use the bicycle. Also, the literature

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based on TPB treats the lack of infrastructure and safety concerns as a barrier that affects perceived behavioral control (de Sousa, 2014).

TABLE 1 – QUESTIONNAIRE ITEMS

Construct	Code	Questionnaire item	What it measures
Attitude (AT)	AT1	Using a bicycle for my daily commute is convenient.	Perceived convenience / instrumental evaluation
	AT2	Using a bicycle for my daily commute is pleasant.	Affective evaluation / pleasure of use
	AT3	I consider using a bicycle for my daily commute to be a good choice.	Overall positive evaluation
	AT4	I consider using a bicycle for my daily commute to be a good way of travelling.	Evaluation of cycling as a travel mode
Subjective Norm (SN)	SN1	People in my family think that I should use a bicycle for my daily commute.	Perceived normative expectations of family
	SN2	People who are important to me think that I should use a bicycle for my daily commute.	Perceived normative expectations of important others
	SN3	People whose opinion I value would approve of my using a bicycle for my daily commute.	Perceived social approval
	SN4	Most people who are important to me would support my decision to use a bicycle for daily commute.	Perceived social support
Perceived Behavioral Control (PBC)	PBC1	I feel capable of using a bicycle for my daily commute.	Perceived capability
	PBC2	I feel confident in my cycling abilities.	Self-efficacy / confidence in cycling abilities
	PBC3	Whether I use a bicycle for my daily commute is largely under my control.	Control over the decision
	PBC4	I can decide for myself whether or not to use a bicycle for my daily commute.	Autonomy
Environmental Perception (EP)	EP1	Bicycle use reduces air pollution.	Perceived reduction in air pollution
	EP2	Bicycle use reduces noise pollution.	Perceived reduction in noise pollution
	EP3	Bicycle use contributes to reducing greenhouse gas emissions.	Perceived contribution to reducing greenhouse gas emissions
	EP4	Bicycle use contributes to a more environmentally sustainable city.	Perceived contribution to urban environmental sustainability
Infrastructure (INF)	INF1	There are sufficient bicycle lanes for my daily commute.	Perceived availability/sufficiency of cycling infrastructure
	INF2	The bicycle lane network provides well-connected routes for my daily commute.	Perceived network connectivity
	INF3	The bicycle lanes are properly maintained.	Perceived infrastructure maintenance/quality
	INF4	There are sufficient bicycle parking facilities.	Perceived availability of bicycle parking
Traffic Safety (SAF)	SAF1	I feel safe when I use a bicycle in traffic.	Perceived traffic safety
	SAF2	Drivers generally behave safely towards cyclists.	Perceived safety of driver behavior
	SAF3	The risk of an accident is low when I use a bicycle.	Perceived accident risk
	SAF4	Traffic conditions allow me to cycle safely.	Perceived safety of traffic conditions
Behavioral Intention (INT)	INT1	I intend to use a bicycle for commuting in the next three months.	Behavioral intention
	INT2	I plan to use a bicycle for commuting in the next three months.	Behavioral planning
	INT3	I will try to use a bicycle for commuting in the next three months.	Intended effort / behavioral commitment

Source: Own processing

Bicycle infrastructure (INF) reveals how friendly is the bicycle lane network for the respondent's daily commuting. It assess availability, network connectivity, infrastructure maintenance, and parking facilities.

Traffic safety (SAF) assesses the personal safety when cycling. It measures the perceived traffic safety, safety of driver behavior, perceived accident risk, and perceived safety of traffic conditions.

Environmental perception (EP) measures respondents' perceptions of the environmental benefits of cycling. It is assessed using four items addressing the perceived contribution of cycling to reducing air pollution and noise pollution, reducing greenhouse gas emissions, and promoting urban environmental sustainability.

A five-point Likert-type scale was used to measure the latent constructs. The response categories were defined as follows: 1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, and 5 = Strongly agree. The same response scale was applied consistently across all measurement items to ensure comparability among the constructs included in the structural equation model.

3.2. Structural Equation Model

The structural equation model was developed based on the Ajzen's (1991) canonic TPB model, extended to account for contextual and environmental factors relevant to daily bicycle commuting (Figure 1). Behavioral Intention (INT) to use a bicycle for daily commuting represents the endogenous outcome variable of the structural model.

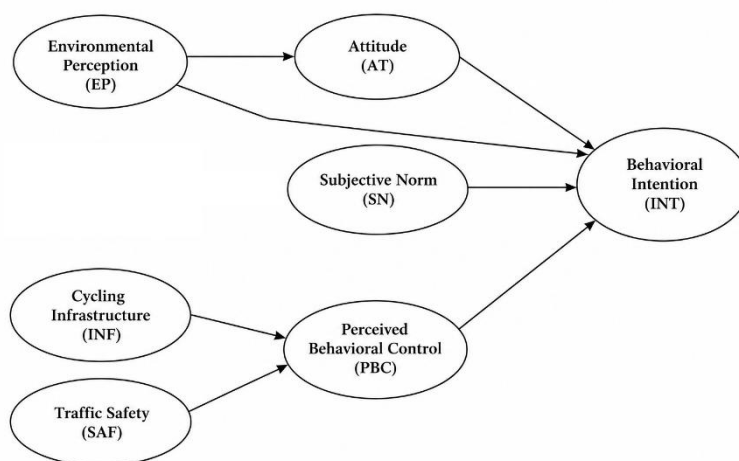


FIGURE 2 – STRUCTURAL EQUATION MODEL

Source: Own processing

AT, SN, and PBC are specified as direct predictors of INT. The model is extended through the inclusion of Environmental Perception. EP captures respondents' perceptions of the environmental consequences of bicycle use, including reductions in air and noise pollution, greenhouse gas emissions, and

contributions to urban environmental sustainability. EP is not treated just as an additional direct determinant of intention, but it may also contribute to the formation of a favorable Attitude (AT) toward bicycle commuting (Zhu et al., 2020). This relationship reflects the possibility that individuals who perceive cycling as environmentally beneficial may evaluate the AT more positively. The model specifies both $EP \rightarrow AT$ and $EP \rightarrow INT$, allowing to investigate an indirect pathway through attitude and a direct association between environmental perception and behavioral intention. The model further incorporates Cycling Infrastructure (INF) and Traffic Safety (SAF) as contextual antecedents of Perceived Behavioral Control (PBC). This specification is theoretically grounded in the conceptualization of PBC as reflecting perceived facilitating and inhibiting factors affecting the performance of behavior (Ilie et al., 2016; Irawan et al., 2022; Quintero-Gómez & Calvo-Báscones, 2026). The availability, connectivity, maintenance, and parking facilities of cycling infrastructure can influence the extent to which individuals recognize bicycle commuting as feasible and controllable. Perceptions of traffic safety, driver behavior, accident risk, and traffic conditions can affect the perceived ability to perform bicycle commuting safely (Jahanshahi et al., 2025). Ajzen's formulation of PBC explicitly recognizes that perceived control is related to facilitating and inhibiting factors surrounding the behavior. Thus, the model specifies the indirect pathways $INF \rightarrow PBC \rightarrow INT$ and $SAF \rightarrow PBC \rightarrow INT$.

The proposed SEM integrates the psychological mechanisms of the TPB with contextual characteristics of the cycling environment. This specification allows the study to examine not only the direct determinants of bicycle commuting intention but also the mediating mechanisms through which environmental perception, cycling infrastructure, and traffic safety may influence intention. Consequently, the following research questions are raised:

- RQ1 – To what extent do the core Theory of Planned Behavior constructs—attitude, subjective norm, and perceived behavioral control—explain the intention to use a bicycle for daily commuting?
- RQ2 – Does environmental perception influence directly and indirectly the intention to use a bicycle for daily commuting?
- RQ3 – Does perceived cycling infrastructure influence perceived behavioral control over bicycle commuting?
- RQ4 – Does perceived traffic safety influence perceived behavioral control over bicycle commuting?
- RQ5 – Do perceived cycling infrastructure and traffic safety influence the intention to use a bicycle for daily commuting indirectly through perceived behavioral control?

3.3. Participants and Data Collection

The participants were recruited among the residents of Bucharest, the capital of Romania, where there is an extensive network of bicycle lanes and the cycling masterplan provides its extension up to 250 km in the near future. The questionnaire was developed using Google Forms and distributed online through social media platforms. To ensure the relevance of the answers, three inclusion criteria were used: (i) people who reside in Bucharest, (ii) people who can ride a bicycle, and (iii) people who regularly commute to work, education, or another destination. The participants were informed about the purpose of the research, the voluntary nature of the participation and how the answers were to be used. Before filling in the questionnaire, they expressed their informed consent to participate. The answers were collected and processed anonymously, without requesting data that would allow the direct identification of the participants. The data were used exclusively for academic purposes and analyzed in aggregate form, respecting the confidentiality of the participants. During the research, 278 responses were collected. Of these, 26 were invalidated due to missing data, thus the valid sample consists of 252 responses. The data were collected during the time interval May-June 2026.

4. RESEARCH RESULTS AND DISCUSSIONS

Table 2 depicts the demographic data for the participants including the gender, age, levels of education, and job occupation.

TABLE 2 – DEMOGRAPHIC AND SOCIO-ECONOMIC SAMPLE DATA (N = 252)

Category	Frequency	Percentage
Gender		
• Female	70	27.78
• Male	182	72.22
Age (years)		
• < 18	28	11.11
• 19-24	86	34.13
• 25-34	93	36.90
• 35-44	31	12.30
• > 45	14	5.56
Education level		
• Secondary	31	12.30
• High school	122	48.41
• Bachelor's degree	67	26.59
• Master's degree	32	12.70
Employment status		
• Full-time employed	163	64.68
• Part-time employed	15	5.95
• Student (only educational activity)	74	29.37

Source: Own processing

The internal reliability and the convergent validity of the latent constructs are summarized in Table 3.

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TABLE 3 – RELIABILITY AND VALIDITY OF THE CONSTRUCTS

Construct	Item	Loading factor	Cronbach's alpha	Composite reliability	AVE
AT	AT1	0.849	0.865	0.905	0.706
	AT2	0.762			
	AT3	0.937			
	AT4	0.803			
SN	SN1	0.775	0.794	0.885	0.659
	SN2	0.880			
	SN3	0.821			
	SN4	0.767			
PBC	PBC1	0.893	0.880	0.910	0.718
	PBC2	0.907			
	PBC3	0.795			
	PBC4	0.788			
EP	EP1	0.766	0.830	0.875	0.637
	EP2	0.790			
	EP3	0.826			
	EP4	0.808			
INF	INF1	0.815	0.799	0.892	0.674
	INF2	0.906			
	INF3	0.841			
	INF4	0.709			
SAF	SAF1	0.886	0.865	0.901	0.695
	SAF2	0.779			
	SAF3	0.846			
	SAF4	0.820			
INT	INT1	0.899	0.902	0.930	0.816
	INT2	0.894			
	INT3	0.917			

Source: Own processing

All twenty-seven observed variables have high loading factors, ranging from 0.709 to 0.937, Therefore, each indicator contributes significantly to the measurement of the latent construct to which it belongs. All seven constructs have Cronbach's alpha values higher than 0.70. This result indicates a reliable level of internal consistency for the scales used in the model. Composite Reliability (CR) reflects the consistency of the indicators within the latent construct, and the AVE indicates the average proportion of indicator variance explained by the construct. All latent variables show $CR \geq 0.70$ and $AVE \geq 0.50$. Therefore, the results support the composite reliability and convergent validity of the measurement model. The discriminant validity is analyzed on the basis of the Fornell–Larcker criterion: for each construct, the square root of the AVE must be greater than its correlations with the other constructs (Table 4). On the main diagonal the $\sqrt{AVE}$ values are shown, and the values outside the diagonal represent the correlation coefficients between the latent constructs. As Table 4 shows, the discriminant validity is verified.

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TABLE 4 – DISCRIMINANT VALIDITY OF THE CONSTRUCTS

Construct	AT	SN	PBC	EP	INF	SAF	INT
AT	0.840						
SN	0.208	0.812					
PBC	0.311	-0.097	0.847				
EP	0.610	0.166	0.231	0.798			
INF	0.123	-0.014	0.410	0.046	0.821		
SAF	0.015	-0.107	0.421	-0.081	0.303	0.834	
INT	0.442	0.118	0.464	0.309	0.199	0.401	0.903

Source: Own processing

The model was estimated by Weighted Least Squares Mean and Variance adjusted (WLSMV), suitable for ordinal Likert-type indicators (Figure 2). The fit results are: CFI = 0.991, TLI = 0.990, RMSEA = 0.044. SRMR = 0.073. The CFI and TLI values indicate a very good match between the theoretical model and the observed data. Both values are well above the usual threshold of 0.90. RMSEA indicates a low approximation error, and SRMR is below the 0.08 threshold commonly used for an acceptable fit.

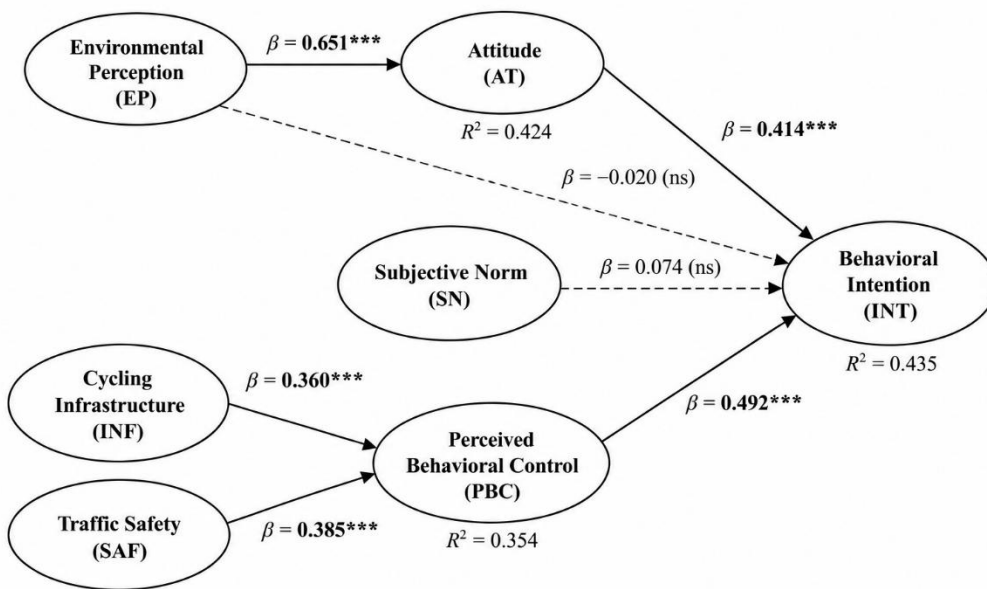


FIGURE 2 – RESULTS OF THE SEM

Source: Own processing

The environmental perception is highly correlated to attitude ($\beta = 0.651, p < 0.001$). Thus, people who consider bicycle as a way to reduce air pollution, noise, and greenhouse gas emissions and as a means of supporting a more sustainable city also tend to show a more favorable attitude towards the use of bicycles. $R^2 = 0.424$ – it means that 42.4% of the variation in AT is explained by the EP.

There is a strong positive relation between attitude and intention to use the bicycle as a commuting transport mean ($\beta = 0.414, p < 0.001$). Under the current model, attitude is one of the main direct

predictors of behavioral intent. This is one of TPB's core relationships and is clearly supported by the results.

The model does not exhibit a direct effect between the environmental perception and intention to use the bicycle ($\beta = -0.020, p = 0.846$). The influence of environmental perception on intention is mainly conveyed through attitude $EP \rightarrow AT \rightarrow INT$, rather than through a direct relationship between $EP \rightarrow INT$. The indirect effect $EP \rightarrow AT \rightarrow INT$ is 0.321 ($p < 0.001$). The positive perception of environmental benefits contributes to the intention to use the bicycle by forming a favorable attitude. This relationship is compatible with an indirect mediation, since the indirect effect is significant, while the direct effect is not.

The relation between the social norm and the intention is statistical non-significant ($\beta = 0.074, p = 0.276$). Thus, the opinion of people close to the individual cannot determine the bicycle use for commuting. The decision to use the bicycle for daily commuting is more strongly determined by personal assessment of behavior and perception of control over behavior than by social approval.

Perceived behavioral control has the greatest influence on intention ($\beta = 0.492, p < 0.001$). This result underpins one of the fundamental components of TPB ($PBC \rightarrow INT$). People who perceive themselves as able to use the bicycle, who are confident in their own abilities and perceive the use of the bicycle as largely under their control have a higher intention to use.

The relation between cycling infrastructure INF and PBC ($\beta = 0.360, p < 0.001$) reveals that the perception of a cycling-friendly infrastructure is positively associated with perceived behavioral control. Respondents who perceive the existence of extended, connected, and well-maintained lanes and adequate parking facilities tend to perceive the use of bicycles as easier to achieve and more under their control.

In the same manner, there is a more favorable perception of traffic safety SAF is associated with a higher level of perceived behavioral control ($\beta = 0.385, p < 0.001$). Respondents who perceive traffic as safer, driver behavior as more smooth, and accident risk as lower tend to perceive bicycle use as more feasible and more under their control.

The mediation relations $INF \rightarrow PBC \rightarrow INT$ ($0.198, p < 0.001$) and $SAF \rightarrow PBC \rightarrow INT$ ($0.192, p < 0.001$) are positive and significant and represent important extensions of TPB, because they introduce contextual factors into the psychological mechanism of behavioral control. $R^2 = 0.354$ indicates that 35.4% of PBC variation is explained by INF and SAF.

For the intention to use bicycle as a commuting transport mean, $R^2 = 0.435$. AT, EP, SN and PBC together explain 43.5% of the variation in the intention to use the bicycle, that indicates a relevant explanatory capacity of the model.

The research questions are summarized in Table 5.

TABLE 5 – RESEARCH QUESTIONS FINDINGS

Research question	Investigated relation	Comments
RQ1	AT → INT SN → INT PBC → INT	Significant Non-significant Significant
RQ2	EP → AT EP → INT EP → AT → INT	Significant Direct effect non-significant Indirect effect through AT is significant
RQ3	INF → PBC	Significant
RQ4	SAF → PBC	Significant
RQ5	INF → PBC → INT SAF → PBC → INT	Significant indirect effect through PBC Significant indirect effect through PBC

Source: Own processing

5. CONCLUSIONS

The present study investigates the determinants of bicycle use intention for daily commuting, extending the Theory of Planned Behavior with three additional dimensions: perception of environmental benefits, cycling infrastructure, and traffic safety. The proposed model enlarges the traditional psychological drivers of behavioral intention (attitude, subjective norm, and perceived behavioral control), with the mechanisms by which environmental factors and contextual conditions can influence these psychological dimensions. The results confirm the central role of attitude and perceived behavioral control in explaining the intention to use the bicycle for commuting. Respondents who rate bicycle use, their own ability, and the possibility to control the achievement of the behavior more favorably tend to manifest a stronger intention to use the bicycle. The results outline the importance of contextual conditions, in particular cycling infrastructure and traffic safety. Both factors have significant indirect effects on bicycle use intention. These findings suggest that the perception of the feasibility of cycling is influenced not only by their own abilities, but also by the physical environment and traffic conditions in which the journey takes place.

A particular finding concerns the role of subjective norms. The opinions of significant others (e.g., family, friends) do not influence the individuals' intention to use bicycle for daily commuting. This result suggests that the relevance of subjective norms is not universal but may depend on the social and cultural mechanisms of societies. The extent to which social expectations translate into behavioral intentions may therefore vary according to the degree of social pressure, collective orientation, and normative

acceptance associated with a particular behavior. In the Romanian context, bicycle-use intentions is more dependent on personal attitudes and perceived behavioral control than social perspectives.

Similarly, the awareness of the environmental perception does not directly translate into a greater intention to use the bicycle. The result highlights an important psychological mechanism: the perception of environmental benefits seems to influence behavioral intent primarily by forming a favorable attitude toward cycling rather than a direct effect on intent. This mechanism may also question the role of educational and informational factors in shaping how individuals understand, internalize environmental benefits and act accordingly.

The study also has some limitations. The analysis focuses on behavioral intent and not on actual cycling behavior. According to TPB, intention is an important proximal determinant of behavior, but it may be a gap between intention and actual behavior. Future studies should include the frequency of cycling, sustainable transport alternatives, or longitudinal measurements of behavior. The study is based on self-reported perceptions, which may be affected by response biases and common variation in the measurement method. Future research could combine questionnaire responses with objective indicators of cycling infrastructure, traffic conditions, and travel distances.

Future research could investigate how population characteristics or urban context influence the intention to commute by bicycle. Differences in age, gender, income, occupational status, bicycle ownership, distance to work, or previous cycling experience could highlight distinct behavioral mechanisms, which was not possible now due to the small subgroups samples. The use of multi-group SEM would allow testing the invariance of structural relationships between these categories.

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