

PSYCHOLOGICAL ASPECTS OF TRAFFIC BEHAVIOR AND RULE VIOLATIONS: AN EMPIRICAL STUDY OF ROAD USERS IN THE STREETS OF TETOVO

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Abstract

This study examines traffic behavior and rule compliance among road users in the city of Tetovo, focusing on observable violations among drivers and pedestrians at signalized and non-signalized intersections.

An empirical field observation was conducted on December 21, 2023, at two selected intersections in Tetovo. A total of 82 vehicles were observed using a structured behavioral checklist. The data were analyzed using descriptive statistical methods to identify frequencies of specific traffic violations.

The results indicate a relatively low level of compliance with basic traffic regulations. The most frequently observed violations included lack of seatbelt use, failure to yield, mobile phone use while driving, and disregard for pedestrian priority. These violations were observed in both types of intersections, with slightly higher frequency at the signalized location.

The findings suggest persistent non-compliant driving behaviors in urban traffic settings. The study highlights the importance of targeted road safety interventions, including public awareness campaigns, enforcement measures, and educational programs. Further research is needed to explore underlying factors influencing driver behavior in similar urban contexts.

Keywords: traffic psychology, road safety, driver behavior, rule violations, empirical research.

1. Introduction

Traffic safety remains one of the most important public health challenges in contemporary urban environments, directly affecting mortality, injury rates, mobility, and quality of life. According to the World Health Organization (WHO, 2021), road traffic accidents are among the leading causes of death worldwide, resulting in approximately 1.3 million fatalities and millions of injuries annually.

In many countries, including North Macedonia, traffic rule violations such as speeding, failure to yield, and non-compliance with traffic signals remain common contributors to road accidents. Official reports indicate that a significant proportion of traffic incidents are associated with human-related factors (State Statistical Office, 2023).

Previous research in traffic safety has shown that road user behavior plays a key role in traffic outcomes. While some studies discuss behavioral and cognitive influences on driving, many urban contexts still lack localized empirical observational data on actual traffic behavior in real-life settings.

Tetovo has experienced increasing traffic density and urban mobility challenges in recent years, particularly in central areas such as intersections near schools and marketplaces. Despite this, there is limited systematic empirical research focusing on observed traffic behavior in this city. Therefore, this study aims to examine traffic behavior and rule compliance among drivers and pedestrians in Tetovo using direct field observation. The research focuses on identifying the frequency of observable traffic violations at both signalized and non-signalized intersections.

The study addresses the following research questions:

1. What is the observed behavior of drivers and pedestrians in Tetovo regarding basic traffic rules?

2. Are there differences in observed behavior depending on the type of intersection (signalized vs. non-signalized)?

This study contributes to the understanding of urban traffic behavior through empirical observation and provides data that may support future road safety interventions and policy development in similar urban environments.

2. Methods and Materials

This study investigates observable traffic behavior among road users in the city of Tetovo, focusing on drivers, pedestrians, and cyclists. The main research question is: to what extent do road users comply with basic traffic rules in selected urban intersections, and what are the most common observable violations?

The study is an empirical, field-based observational research. Data were collected through direct non-participant observation, aiming to record real-world traffic behavior without intervention or interaction with participants. The study is descriptive in nature and focuses on frequency patterns of observed behaviors. (Creswell, 2014); (Kothari, 2004).

2.1 Population, Sample, and Sampling Method: The target population includes drivers of passenger vehicles, pedestrians, and cyclists in urban traffic in Tetovo.

The observational sample consisted of:

- 82 observed vehicles
- 80 observed pedestrians
- cyclists observed opportunistically during the observation period

Vehicles were observed using a systematic observation approach, recording every third passing vehicle during the defined time intervals at the selected locations.

No random sampling was applied, as the study is based on real-time traffic flow observation in natural settings.

2.2 Time, Location, and Research Tools: The study was conducted on December 21, 2023, between 13:00 and 14:00, at two urban intersections in Tetovo:

1. Blvd. “Blagoja Toska” with “29 November” Street (non-signalized intersection)
2. Blvd. “Vidoe Smilevski Bato” with “29 November” Street (signalized intersection)

These locations were selected due to their high traffic density and relevance for observing everyday traffic behavior. (Figure 1 and Figure 2).

2.3 Data Collection and Analysis Method: Data were collected through structured observation sheets developed for drivers and pedestrians. The observation instrument included predefined behavioral indicators related to traffic rule compliance.

For drivers, recorded indicators included seatbelt use, compliance with traffic signals, yielding behavior, mobile phone use while driving, lane discipline, and illegal stopping or parking.

For pedestrians, observed indicators included crossing behavior at traffic lights and crossing outside designated pedestrian crossings.

Cyclist behavior was recorded when cyclists were present during the observation period; however, this component is considered supplementary due to its lower frequency in the observed timeframe.

Observers recorded behaviors in real time without interaction with participants, ensuring non-intrusive data collection.

2.4 Data analysis: Data were analyzed using descriptive statistical methods, including frequency counts and percentage distributions of observed violations by category and location. All data were processed using Microsoft Excel. The study does not include inferential statistical analysis, as its aim is to describe observable behavioral patterns rather than test hypotheses or causal relationships

2.5 Methodological Framework: The study is based on non-participant observational methods commonly used in traffic behavior research. This approach enables the recording of actual behavior in natural traffic environments without self-report bias.

Observational methods are widely applied in road safety research to assess compliance with traffic regulations and identify behavioral risk patterns in real-world conditions (WHO, 2021) (OECD/ITF, 2020).

The study follows a descriptive observational framework aimed at identifying patterns of rule compliance and violation among urban road users. It does not attempt to measure psychological constructs directly, but rather focuses on observable behavioral indicators.

FORMULARI I VËZHIMIT TË AUTOMJETEVE FORMULAR НА НАБЉУДУВАЊЕ НА ВОЗИЛАТА

Data dhe ora: /Датум и час:											
Vendi/Mesto:											

Lloji i automjetit/ Вид на возило:	Nr.rend./Ред.бр.		1	2	3						10
	Motocikël/Motorцикл:	Vetura/Aвтомобил:									
Gjinia/Пол:	Kombi-BUS/Комби -Автобус	Automjete për ngarkesa/Tоварно возило									
	Mashkull/Mашко	Femër/Jенско									

Respektimi i semaforit	Респектима на семафорот	PO/ДА									
Pochituvanje на семафорот	Почитување на семафорот	JO/НЕ									
Venia e gipit të sigurimit	Вениа е гипит тѐ сигуримит	PO/ДА									
Koristene на сигурносен појас	Користене на сигурносен појас	JO/НЕ									
Respektimi i këmbësorëve	Респектима и кѐмбѐсорѐвѐ	PO/ДА									
Pochituvanje на пешаците	Почитување на пешаците	JO/НЕ									
Përdorimi i celularit	Пѐрдорима и сѐлуларит	PO/ДА									
Употреба на мобилен телефон	Употреба на мобилен телефон	JO/НЕ									
Ndalja/parkimi jo ligjor	Ндалја/паркима жо лигоре	PO/ДА									
Непрописно запирање/паркирање	Непрописно запирање/паркирање	JO/НЕ									
Lëvizje-rreshtim jo në rregull	Лѐвизје-ррѐштима жо нѐ ррегулл	PO/ДА									
Непрописно движење/престројување	Непрописно движење/престројување	JO/НЕ									
Respektimi i përparësisë së kalimit	Респектима и пѐрпарѐсисѐ сѐ калимит	PO/ДА									
Давање на првенство на минуваче	Давање на првенство на минуваче	JO/НЕ									

Vërejtje: Të dhënat e mbledhura do të përdoren vetëm qëllime shkencore-hulumtuese.
Напомена: собраните податоци ќе се употребат само за научно-истражувачки цели

Figure 1 Vehicle Observation Form

FORMULARI I VËZHIMIT TË FORMULAR НА НАБЉУДУВАЊЕ НА KËMBËSORËVE/BIÇIKLISTËVE ПЕШАЦИ/ВЕЛОСИПЕДИСТИ

Data dhe ora: /Датум и час:											
Vendi/Mesto:											

Moshë /Возраст:	Nr.rend./Ред.бр.										
	fëmijë/Дете:	nxënës-student/ученик-студент:	i rritur -возрасен	në moshë /старин години							
Gjinia/Пол:	Mashkull/Mашко	Femër/Jенско									

Këmbësorë/Пешаци											
Kalimi në vendkalim për këmbësorë	Калима нѐ вѐндкалим пѐр кѐмбѐсорѐ	PO/ДА									
Преминување на пешачки премин	Преминување на пешачки премин	JO/НЕ									
Respektimi i semaforit	Респектима и семафорит	PO/ДА									
Pochituvanje на семафорот	Почитување на семафорот	JO/НЕ									
Biçiklistë/Велосипедисти											
Respektimi i këmbësorëve	Респектима и кѐмбѐсорѐвѐ	PO/ДА									
Pochituvanje на пешаците	Почитување на пешаците	JO/НЕ									
Përdorimi i celularit	Пѐрдорима и сѐлуларит	PO/ДА									
Употреба на мобилен телефон	Употреба на мобилен телефон	JO/НЕ									
Lëvizje-rreshtim jo në rregull	Лѐвизје-ррѐштима жо нѐ ррегулл	PO/ДА									
Непрописно движење/престројување	Непрописно движење/престројување	JO/НЕ									
Respektimi i përparësisë së kalimit	Респектима и пѐрпарѐсисѐ сѐ калимит	PO/ДА									
Давање на првенство на минуваче	Давање на првенство на минуваче	JO/НЕ									

Vërejtje: Të dhënat e mbledhura do të përdoren vetëm qëllime shkencore-hulumtuese.
Напомена: собраните податоци ќе се употребат само за научно-истражувачки цели

Figure 2 Pedestrian Observation Form

3. Results

The aim of the study was to examine observable traffic behavior among drivers, pedestrians, and cyclists in Tetovo through field observation at two intersections (signalized and non-signalized). The results are presented as frequencies and percentages of observed behaviors.

Table 1. Drivers' Behavior at Non-Signalized Intersection

Indicator	Yes (Count)	Yes (%)	No (Count)	No (%)
Use of seatbelt	12	14.6 %	68	82.9 %
Yielding to pedestrians	47	57.3 %	33	40.2 %
Use of mobile phone	30	36.6 %	50	61.0 %
Illegal stopping/parking	13	15.9 %	67	81.7 %
Improper lane changing	36	43.9 %	44	53.7 %
Yielding right-of-way	48	58.5 %	32	39.0 %

Table 2. Drivers' Behavior at Signalized Intersection

Indicator	Yes (Count)	Yes (%)	No (Count)	No (%)
Compliance with traffic light	10	12.2 %	72	87.8 %
Use of seatbelt	15	18.3 %	65	79.3 %
Yielding to pedestrians	53	64.6 %	27	32.9 %
Use of mobile phone	25	30.5 %	55	67.1 %
Illegal stopping/parking	10	12.2 %	70	85.4 %
Improper lane changing	41	50.0 %	39	47.6 %
Yielding right-of-way	51	62.2 %	29	35.4 %

3.1 Drivers' Behavior

- At the non-signalized intersection, seatbelt use was observed in 14.6% of drivers, while 82.9% did not use seatbelts. At the signalized intersection, seatbelt use was 18.3%.
- Compliance with traffic signals at the signalized intersection was observed in 12.2% of drivers.
- Mobile phone use while driving was observed in 36.6% of drivers at the non-signalized intersection and 30.5% at the signalized intersection.
- Yielding to pedestrians was observed in 57.3% of cases at the non-signalized intersection and 64.6% at the signalized intersection.
- Right-of-way compliance was observed in approximately 58.5% and 62.2% of cases respectively.
- Illegal stopping or parking and improper lane changing were observed in both locations, with values ranging between 15.9%–12.2% and 43.9%–50.0% respectively.

Table 3. Cyclists' Behavior at Non-Signalized Intersection

Indicator	Compliance (Count)	Non-Compliance (Count)	Compliance (%)
Yielding to pedestrians	17	23	42.5%
Use of mobile phone	3	37	7.5%
Improper movement/lane changing	19	21	47.5%
Yielding right-of-way	29	11	72.5%

Table 4. Cyclists' Behavior at Signalized Intersection

Indicator	Compliance (Count)	Non-Compliance (Count)	Compliance (%)
Yielding to pedestrians	24	16	60.0%
Use of mobile phone	4	36	10.0%
Improper movement/lane changing	15	25	37.5%
Yielding right-of-way	31	9	77.5%

3.2 Cyclists' Behavior

- Cyclists demonstrated varying levels of compliance across observed indicators. Yielding to pedestrians ranged from 42.5% at the non-signalized intersection to 60.0% at the signalized intersection.
- Mobile phone use among cyclists was observed in 7.5%–10.0% of cases.
- Improper movement and lane changing ranged from 37.5% to 47.5%.
- Right-of-way compliance ranged from 72.5% to 77.5%.

Table 5. Pedestrians' Behavior at Non-Signalized Intersection

Indicator	Compliance (Count)	Non-Compliance (Count)	Compliance (%)
Using marked pedestrian crossing	25	15	62.5%

Table 6. Pedestrians' Behavior at Signalized Intersection

Indicator	Compliance (Count)	Non-Compliance (Count)	Compliance (%)
Using marked pedestrian crossing	29	11	72.5%
Compliance with traffic signals	28	12	70.0%

3.3 Pedestrians' Behavior

- At the non-signalized intersection, 62.5% of pedestrians used marked crossings. At the signalized intersection, this increased to 72.5%.
- Compliance with traffic signals at the signalized intersection was observed in 70.0% of pedestrians.

4. Discussion

The results of this observational study provide descriptive evidence on traffic behavior among drivers, cyclists, and pedestrians in Tetovo. The findings indicate varying levels of compliance with traffic regulations across different user groups and intersection types.

4.1 Driver Behavior and Risk Patterns: The observed compliance with traffic signals at the signalized intersection (12.2%) appears lower compared to findings reported in similar urban contexts. This difference may suggest potential challenges related to enforcement or behavioral adaptation in local traffic conditions.

Seatbelt use was observed at relatively low levels (14.6%–18.3%). According to the (WHO, 2021), seatbelts significantly reduce the risk of severe injury in road accidents, which highlights the importance of improving compliance in this area.

Mobile phone use while driving (30.5%–36.6%) is consistent with findings from previous research identifying driver distraction as an important risk factor in urban traffic environments (Strayer & Drews, (2004)). Such behavior may contribute to reduced driver attention and delayed response in traffic situations.

Other observed behaviors, including improper lane changes, illegal stopping, and failure to yield, were relatively frequent in both locations, suggesting variability in compliance with traffic regulations in everyday urban driving conditions.

4.2 Cyclists: Between Vulnerability and Informality: Cyclists demonstrated moderate compliance in some indicators, particularly yielding behavior (42.5%–60%) and right-of-way compliance (72.5%–77.5%). However, non-compliance was also observed in certain behaviors, including improper movement and lane usage.

Previous research suggests that cyclist behavior in urban environments is often influenced by infrastructure conditions and the availability of dedicated cycling facilities (Tom & Granić, 2021). In this context, the observed behavior may reflect both individual compliance and broader infrastructural constraint.

4.3 Pedestrian Behavior: Moderate Compliance Levels: Pedestrians demonstrated relatively higher compliance compared to other groups. At the signalized intersection, 72.5% used marked crossings and 70% complied with traffic signals.

However, non-compliant behavior was still observed among a proportion of pedestrians, particularly at the non-signalized intersection. Similar patterns have been reported in regional studies, such as (Tom & Granić, 2021), where pedestrian compliance varied depending on infrastructure and traffic control conditions.

4.4 Implications for Traffic Safety: The findings of this study may have implications for traffic safety planning and policy development in urban environments. They suggest that improvements in road safety could benefit from a combination of enforcement, education, and infrastructure measures.

Potential areas for consideration include:

1. Strengthening enforcement of traffic regulations at intersections
2. Increasing public awareness regarding seatbelt use and mobile phone risks
3. Enhancing traffic education initiatives
4. Improving pedestrian and cycling infrastructure
5. Using local observational data to inform targeted interventions in high-traffic areas

These suggestions are presented as potential directions for improving road safety rather than prescriptive recommendations.

4.5 Summary of Discussion: Overall, the findings indicate variability in traffic rule compliance among different user groups in Tetovo. When compared with findings from other contexts, the results suggest areas where further attention may be beneficial in terms of road safety policy and behavioral interventions.

5. Conclusion and Recommendations

This study examined observable traffic behavior among drivers, pedestrians, and cyclists in Tetovo through direct field observation. The findings provide descriptive evidence of varying levels of compliance with traffic regulations across different road user groups and intersection types.

5.1 Motor Vehicle Drivers: Observed driver behavior showed relatively low compliance with several key traffic rules, particularly seatbelt use and compliance with traffic signals. Mobile phone use while driving was also frequently observed across both intersections.

Yielding behavior showed moderate levels of compliance, while other behaviors such as lane discipline and illegal stopping were also present in the observed traffic flow.

These findings are consistent with previous research that highlights driver distraction as a significant risk factor in urban traffic environments (Strayer & Drews, (2004)). Similarly, international road safety reports emphasize the importance of seatbelt use and compliance with basic traffic regulations in reducing traffic-related injuries (WHO, 2021).

Recommendations:

1. Strengthen enforcement of existing traffic regulations
2. Increase visibility of monitoring systems at key intersections
3. Promote public awareness campaigns on road safety
4. Enhance traffic education programs in driving schools (Creswell, 2014).

5.2 Cyclists: Cyclist behavior showed mixed levels of compliance. While some behaviors, such as yielding to pedestrians and right-of-way compliance, were relatively frequent, other behaviors indicated lower compliance levels in terms of movement discipline.

These findings may be partially explained by infrastructural and regulatory factors. Previous studies suggest that cycling behavior in urban areas is strongly influenced by the availability of safe infrastructure and clear traffic regulations (Pucher & Buehler, 2012).

Recommendations:

- Develop dedicated, physically protected cycling lanes.
- Include cyclists in traffic safety education and policy-making.
- Promote a civic identity among cyclists to encourage adherence to norms.
- Clarify and enforce legal obligations for cyclists.

5.3 Pedestrians: Pedestrians demonstrated relatively higher compliance compared to other road user groups, particularly at signalized intersections. However, non-compliant behavior was still observed, especially at non-signalized crossings.

The variation in pedestrian compliance may suggest that intersection design and traffic control mechanisms influence pedestrian behavior in urban environments. Similar patterns have been observed in regional studies, where pedestrian compliance varies depending on infrastructure and traffic conditions (Tom & Granić, 2021).

Recommendations:

- Improve pedestrian crossing infrastructure and visibility
- Use physical design elements (e.g., barriers, markings) to guide pedestrian flow
- Enhance awareness campaigns focusing on pedestrian safety
- Strengthen enforcement in high-risk pedestrian zones.

5.4 General Conclusion: Overall, the study provides descriptive evidence of traffic behavior patterns in Tetovo. The findings suggest variability in compliance with traffic regulations among different categories of road users and across different intersection types.

The results do not directly measure psychological or sociological constructs but rather present observable behavioral indicators that may be influenced by multiple contextual factors such as infrastructure, enforcement, and public awareness.

From a road safety perspective, international guidelines emphasize that combined approaches involving enforcement, education, and infrastructure improvements are most effective in improving compliance and reducing accidents (WHO, 2021); (OECD/ITF, 2020)).

General Recommendations:

- Strengthen coordination between traffic enforcement, education, and urban planning
- Implement evidence-based road safety interventions
- Encourage further research using mixed-method or longitudinal designs
- Utilize local observational data for targeted safety improvements.

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