Executive Report

Understanding Motorcyclists' Behavior, Bogotá

Bogotá

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Executive Summary

This study on motorcyclists' behavior in Bogotá reveals critical insights into risk perception, attitudes, and practices. The research combined quantitative surveys conducted in June 2024 and qualitative focus groups conducted in September 2024. The results uncover a significant disconnect between general risk awareness and personal risk perception among riders. Younger motorcyclists (18-29 year olds) or with short experience consistently demonstrated higher propensity for risky behaviors, including speeding and rule-breaking. Age, rather than gender, emerged as the primary factor influencing attitudes and behaviors. The study highlighted a paradox where some riders rationally understand speed limits but emotionally struggle to adhere to them. Notably, 46% of riders learned to drive a motorcycle informally, raising concerns about safety skills. Personal "traumatic events" were identified as a primary driver of behavioral change, underscoring the urgency for proactive, less harmful approaches to fostering risk awareness. Motorcyclists have shown a very negative perception of punitive enforcement while showing a preference for educational approaches. The findings suggest a need for targeted strategies, particularly for younger riders, combining preventive campaigns, on-road messaging (education), and interactive learning experiences. Recommendations include reframing enforcement as educational opportunities, leveraging community influence, and implementing policy changes to promote responsible riding behavior. On-road education for road safety education for speed offenders is recommended. We recommend defining younger drivers as those up to 24 years old instead of 29, ensuring the norms apply accordingly.

Introduction

According to data collected by Bogotá's transportation authority (Secretaría de Movilidad), in Bogotá and the 12 neighboring municipalities, motorcycle registration increased by 65% between 2019 and 2022. But with the growth of motorcycles are also rising road traffic injuries and fatalities. In 2022, 232 motorcyclists were involved in road fatalities, an increase of 42% compared to 2019 data. Currently in the city, motorcyclists are the main victims of road crashes, surpassing pedestrians and cyclists (Hidalgo, 2023).

The latest official data from 2022 compiled by the authorities reveals the highest number of motorcycle-related fatalities in road casualties since 2016. Alarmingly, the number of motorcyclists and riders who died in road casualties has been on an upward trend, surpassing pedestrian fatalities since 2020, a reversal of the historical trend. In fact, motorcyclists are involved in 63% of all road fatalities, highlighting their significant impact on road safety. This is partly due to the vulnerability of motorcyclists, who are exposed directly to larger vehicles. However, motorcyclists are primarily involved in fatalities of self-injury, pedestrians, and cyclists (SDM, 2023).

This is a concern that is likely to continue to escalate, as this mode of transportation is gaining popularity in Bogotá. According to Jimenez et al. (2015), some of the reasons that led to its growth are accessible prices, financing options, simple registration processes, work tools, the possibility of maneuvering in traffic jams, an alternative option to public transport in areas where coverage and frequency are deficient, and an alternative option with circulation restrictions for private cars.

The increase in motorcycle casualties can be partly attributed to risky driving behavior. Citizens have the perception that part of the motorcyclists have a risky driving behavior, this is evident from the 2022 Road Risk Perception Survey[1], a quantitative study conducted by Bogotá's Transportation Authority (Secretaría de Movilidad), with the following data. Firstly, motorcyclists are perceived as the road users who generate the most irritability and annoyance with their behavior towards other users, and secondly, they are believed to exceed speed limits more frequently than other road users. In addition, the same survey presents data

[1] https://www.movilidadbogota.gov.co/web/sites/default/files/Paginas/12-01-2024/eprv-2022_20230112_0.pdf

that show that there are personal factors of motorcyclists that influence their driving behavior, such as the fact that motorcyclists cite as main reasons for riding motorcycle the sensation of freedom and the enjoyment of high speed (65% of motorcyclists enjoy speed and 44% say riding gives them a feeling of freedom).

In 2017, the city embraced Vision Zero, a comprehensive road safety initiative, aligned with Safe System approach. As part of this strategy, the city enforced speed limits of 50 km/h on arterial roads and 30 km/h in proximity to schools. Additionally, measures were taken to enhance safety for vulnerable road users in commercial areas, incorporating redesigned infrastructure to manage speeds and provide protection for pedestrians and cyclists (ITF, 2022). These efforts reflect a commitment to implementing various interventions by Bogotá's authorities, including infrastructure enhancements, signaling, regulatory measures, and law enforcement.

However, despite these initiatives, the statistics remain unfavorable. This can partly be attributed to the risky driving behaviors exhibited by a substantial portion of motorcyclists, as these behaviors are evident on the roads with situations that are observed every day. It is also reflected in the data with reports of self-injuries and casualties involving more vulnerable road users, such as cyclists and pedestrians. Consequently, this highlights the human complexity and the need for comprehensive strategies that address infrastructure, enforcement and behavior to improve road safety.

Road casualties contributing factors generally fall into three categories: environmental (e.g. undivided, curved, or inclined and casualty-prone roads; weather conditions, interaction with other vehicles and visibility of objects), vehicle (e.g. types of motorcycles, engine displacement, safety maintenance), and human factors (driver's mental and physical capacity, driving style, violations and errors). Causes can be exclusively human, a combination of human and environmental or human and vehicle, or an interplay of all three factors. It is unclear that what exact proportion of road casualties can be attributed to each factor. However, the human factor appears to be a leading determinant. For that reason, it is worthwhile to pay particular attention to this factor since favorable effects on road safety can be achieved by simple behavioral modifications (Jafarpour & Rahimi-Movaghar, 2014).

Research Objectives

- To understand and analyze the factors that influence motorcyclists' behavior on the road, with the goal of uncovering the reasons behind their tendency for risky driving behaviors and providing insights for improving motorcyclist safety in Bogotá, Colombia.
- To identify and analyze factors influencing motorcyclists' road behaviors beyond speeding, including helmet use, carrying extra passengers, and driving under the influence of alcohol.
- To suggest effective strategies and communication messages aimed at enhancing motorcyclist safety, specifically tailored to the context of Bogotá, Colombia.
- To contribute to the generation of new publishable knowledge on motorcyclist behavior and safety, supporting the efforts of Vital Strategies in improving road safety.

Content

This report includes the study description, key findings, analysis, and recommendations. Firstly, the study description outlines the methodology used, including a quantitative survey and qualitative focus groups. Secondly, the key findings present insights into motorcyclists' behavior, attitudes, and perceptions, with a focus on differences by age and gender. Thirdly, the analysis delves into the relationships between personal factors and risky driving behavior, supported by statistical models. Lastly, the report provides recommendations aimed at improving road safety through communication strategies, enforcement, and policy initiatives.

Study Description

The study employed a mixed methods approach, combining a quantitative survey and qualitative focus groups. The survey, conducted with 419 motorcyclists in Bogotá, aimed to identify personal factors influencing risky driving behavior. Additionally, focus groups with participants from various socioeconomic levels provided deeper insights into their perceptions and attitudes toward driving safety (see focus group section below).

The Survey

A survey was applied to identify the relationships between personal factors that explain motorcyclists' risky driving behavior in Bogotá. This methodology included a citywide online survey in Bogotá, Colombia, with a sample of 419 motorcyclists, capturing data on personality traits, attitudes, perceptions, and self-reported risky behaviors.

A questionnaire was designed based on findings and sourced from questionnaires of the literature review (Chen, 2009; Chen & Chen, 2011; Chung & Wong, 2012; Lucidi et al., 2019; Susilo et al., 2015; Theofilatos & Yannis, 2014; Tunnicliff et al., 2012; Ulleberg & Rundmo, 2003; Vuong et al., 2023; Wong et al., 2010; Zheng et al., 2019). The questionnaire included the following sections: (1) Screening (to identify respondents who were motorcyclists in Bogotá, only those who drive a motorcycle three or more times per week were included), (2) personality traits (sensation-seeking and normlessness), (3) unsafe attitude toward speeding, (4) unsafe attitude toward drink driving, (5) fear of enforcement, (6) risky driving behavior, (7) self-reported traffic tickets and fixed object collision in the past two years, and finally, (8) sociodemographic information.

In this study, two personality traits related to risky driving behavior are of interest, sensation-seeking and normlessness (Ulleberg & Rundmo, 2003). Sensation-seeking is an individual's willingness to take physical and social risks encouraged by the individual desire for excitement and stimulation (Wong, Chung, & Huang, 2010; Zheng et al., 2019). According to (Khon & Schooler, 1983), normlessness is how likely is an individual to follow rules or conduct norms imposed by authorities or society.

Survey Sample

In Bogotá and its surrounding municipalities, approximately 1.5 million motorcycles are in operation (El Tiempo, 2023) translating to an estimated population of 1.5 million motorcyclists. The target sample size for this study was set at 450 complete surveys. All participants were motorcycle drivers who ride at least three days per week.

The survey was administered through an online panel during June 2024. After the survey administration and data cleaning process, the final sample size was 419 valid responses. The

average response time for completing the survey was approximately 13 minutes, and the response rate achieved was 73%.

The distribution of the survey was managed through the panel provider following Vital Strategies' sampling requirements. The panel provider was responsible for distributing the survey among their panelists to meet the target sample characteristics and quotas while ensuring data quality standards. The Bogotá's Household Travel Survey (2023 BHTS) served as a reference to guide expected proportions and income levels in the sample, given that precise demographic shares of motorcycle drivers in Bogotá are unknown. The intention was to align the sample with key characteristics such as gender, age, and socioeconomic strata, in order to approximate the population of motorcyclists in the city (see sample distribution in Table 1).

Table 1. Survey Sample distribution

Indicator	2023 BHTS	Survey
Gender*		
Male	85.7%	72.9%
Female	13.9%	27.1%
Age		
18 - 29	39.7%	34.6%
30 - 39	32.6%	35.1%
40 - 55	27.7%	30.3%
SES		
1	19.9%	10.1%
2	37.8%	41.0%
3	29.9%	36.7%
4	6.5%	8.4%
5	2.6%	3.1%
6	3.3%	0.7%

**Note: The gender distribution was not specifically targeted, as there was a desire for a higher representation of females.*

The following points summarize key details about survey's sample:

- 419 adults in Bogotá, aged 18-55, who ride motorcycles at least 3 days a week
- Majority male (72,9%), with a significant portion aged 30-39 (35.1%)

- Most participants come from socioeconomic strata[2] 2 and 3 (77.3% combined)
- 68% use motorcycles 5 or more days per week
- Primary reasons for motorcycle use include commuting, leisure, and work-related purposes

Analysis

For the analysis of the data, we conducted hypothesis testing that allow evaluating if indicators or ratios of different groups could be attributed to random variation or represented true population differences. The differences between means of two independent populations are expressed as the subtraction of their expected values ($\mu_1 - \mu_1$). This difference must be contextualized considering the inherent variability of both populations (σ_1^2, σ_2^2), establishing confidence intervals and p-values that allow determining if the observed differences are statistically significant. In addition, we conducted OLS linear regression models to predict severity of crashes and number of traffic fines.

Focus Groups

The focus groups targeted men and women aged 18 to 40 years, living in Bogotá. Participants were from low-middle, middle, and upper-middle socioeconomic levels, specifically in strata 2, 3, and 4. All participants were motorcycle drivers who ride at least three days per week.

- **Methodology**

  The focus groups were conducted by Target Insights®, a marketing research company, via virtual (online) semi-structured discussions. A total of eight groups were conducted (Table 2), according to the requirements of Vital Strategies, with full coverage of the research objectives. Each session lasted approximately two hours, and participants were compensated for their time (40.000 COP vía electronic money voucher).

- **Recruitment and Quality Control**

  Participants were recruited by Target Insights®, with an emphasis on ensuring they met the target characteristics. To ensure data quality, the process was supported by

[2] Strata (estratos) in Bogotá: A socioeconomic classification system that divides residential areas into 6 categories (1 being the lowest, 6 the highest) based on housing quality and surroundings. Used primarily to determine utility rates, with lower strata receiving subsidies and higher strata paying surcharges.

peer-based indirect supervision of interviewers. Universidad de los Andes and Vital Strategies had a listener present in the focus groups.

Fieldwork was conducted from August 27-29, 2024, with two researchers facilitating the sessions using a moderator guide as the key material for guiding the discussions.

Table 2. Focus groups segmentation

Segment	Age	Socioeconomic Level (NSE)	# participants
Delivery workers, majority men	25-40	Strata 2/3	6
Delivery workers, majority men	25-40	Strata 2/3	6
Women	18-24	Strata 2/3	6
Women	25-40	Strata 2/3	6
Women	25-40	Strata 4[3]	6
Men	18-24	Strata 2/3	5
Men	18-24	Strata 2/3	6
Men	25-40	Strata 2/3	4
Total			**45**

Results of the Quantitative Study (Survey)

The survey provides insight into the behavior, perceptions, and practices of motorcycle riders. The results highlight both the advantages and challenges of motorcycle use in the city, particularly concerning younger riders and their approach to road safety. All the results can be seen in detail in the Descriptive Quantitative Results. Below are the key findings from the survey.

Main Takeaways

- A significant portion of surveyed motorcyclists, 46%, learned to ride informally[4], leading to concerns about skill levels and safety awareness.
- Younger riders experience more severe crashes and engage in riskier behaviors, likely due to their age-related tendencies toward excitement and lower perception of personal danger.

[3] This change in income was requested of Vital Strategies.
[4] In Colombia, the driver's licensing process primarily involves completing a course at private driving academies, after which individuals can request their license. However, those who already know how to drive can waive the course requirement by passing a skills test.

- High self-confidence in riding abilities (e.g., 56% agree/strongly agree they can handle any unexpected situation) contrasts with frequent engagement in risky behaviors, forming the so-called confidence-risk disconnect.
- A paradox was found: High awareness of general risks (81% consider traffic fatalities a serious problem) but low perception of personal risk (only 20% agree they could be involved in a crash).
- Motorcyclists prefer educational approaches over punitive enforcement. Their perception of speed cameras as revenue-generating tools rather than safety measures undermines the credibility of enforcement efforts. This distrust makes enforcement less effective as a deterrent and explains their preference for learning-focused approaches over penalties.
- People who received traffic fines were more likely to be frequent motorcycle users and male. However, these characteristics (frequency of use and gender) did not predict crash severity. This suggests that current enforcement efforts may not be targeting the population most at risk of serious crashes.
- Negative perception of traffic rules: Many riders view strict adherence to traffic rules as detrimental to the benefits of motorcycle use, suggesting a need to reframe the narrative around traffic regulations.

Risk Perception

Risk perception among Bogotá's motorcycle riders presents no significant differences observed between genders or age groups for most measures. Riders generally demonstrate high awareness of broad risks associated with motorcycle riding, as evidenced by high average scores on statements like "The faster I drive, the higher chance of a crash" (Mean = 4.1) and "I feel insecure about the possibility of being injured in a road traffic crash" (Mean = 4.2). However, this awareness contrasts sharply with their low perception of personal risk, indicated by a low average score (Mean = 2.5) for "I consider there is a likelihood that I could be involved in a road traffic crash." This combination of high awareness of general risks, but low perception of personal risk suggests that while riders understand the dangers in theory, they may not fully apply this understanding to their personal riding behavior.

Personality Traits

In the four personality traits examined in the survey (Altruism, Sensation Seeking, Normlessness, and Anger) no major differences are found between genders among motorcycle riders in Bogotá. However, significant age-related differences emerge, particularly in Sensation Seeking and Normlessness. Younger riders (18-29) consistently scored higher in Sensation Seeking traits, showing a greater affinity for strong emotions (Δ Mean = -0.389 ***)[5], being daring (Δ Mean = -0.490 ***), and willingness to try new things (Δ Mean = -0.582 ***). They also displayed higher Normlessness, being more likely to justify breaking rules (e.g., "If something works effectively, it doesn't matter if it's done right or wrong", Δ Mean = -0.536 ***; "Rules and laws can be broken as long as they don't affect other people", Δ Mean = -0.625 ***). These findings suggest that age plays a more crucial role than gender, as these personality traits are more prevalent among younger motorcycle riders, who exhibit more risk-prone characteristics in terms of thrill-seeking and rule-breaking tendencies.

Speeding and Drink Driving Attitudes

In terms of speeding attitudes, there are notable differences between age groups, while for gender differences are inexistent or weak. Younger riders (18-29) consistently showed more permissive attitudes towards speeding compared to older riders (30+). They were more likely to agree that "In Bogotá, the faster I drive, the quicker I get to my destination" (Δ Mean = -0.399 ***), that "Speed limits can be exceeded as long as the driver is experienced" (Δ Mean = -0.460 ***), and that "When the road is empty, it's not so dangerous to drive at high speeds" (Δ Mean = -0.334 **). Gender differences in speeding attitudes were generally smaller and often not statistically significant, with the exception that males were more likely to consider

[5]Henceforth
Significance symbols: A quick way to show the strength of evidence.
*** ($p < 0,001$): Highly significant, strong evidence against H_0.
** ($0,001 < p < 0,01$): Significant, moderate evidence against H_0.
* ($0,01 < p < 0,05$): Moderately significant, some evidence against H_0.
. ($0,05 < p < 0,10$): Marginally significant, weak evidence.

speed limits on main roads in Bogotá as very low (Δ Mean = 0.348 *). Regarding attitudes toward driving under the influence of alcohol (DUI), while overall acceptance was low, younger riders showed a slightly higher tendency to believe that "People have the ability to drive very well after having a few drinks" (Δ Mean = -0.300 **), suggesting a potentially dangerous misconception more prevalent among younger motorcyclists.

Justification for Traffic Violations

In terms of justifying violations, younger riders (18-29) consistently show a higher tendency to do so compared to older riders (30+), while gender differences are less pronounced. They were more likely to agree that "Skipping some minor traffic rules, like rolling through a stop sign when no other cars are around, doesn't make me a serious violator" (Δ Mean = -0.502 ***), and that "If you had to comply with all traffic rules it would not be worth having a motorcycle because it would not be a fast means of transportation" (Δ Mean = -0.544 ***). Younger riders also more strongly believed that "To preserve my safety and integrity on the road, larger vehicles force me to commit traffic infractions while driving a motorcycle" (Δ Mean = -0.402 **). Gender differences in justifying traffic violations were generally smaller and not statistically significant. These findings suggest that age plays a more crucial role than gender in shaping attitudes towards traffic rule compliance, with younger riders more inclined to rationalize breaking traffic rules.

Education and Enforcement

The findings reveal a clear divide between education and enforcement in the minds of respondents when it comes to road safety. There is a strong preference for educational initiatives, with 88% of participants emphasizing the importance of road safety education in schools, and an even greater number (94%) supporting driver education. This suggests a widespread belief in the long-term benefits of equipping individuals with knowledge and skills to promote safer driving behaviors.

In contrast, enforcement measures are met with skepticism. A significant 68% of respondents believe that speed cameras serve more as a business venture than a genuine safety tool,

reflecting distrust in the current enforcement strategies. This sentiment is further complicated by mixed attitudes toward police enforcement. While 78% of respondents express concern about being fined for speeding, only 39% think they are likely to be stopped for drinking and driving. A reevaluation of current enforcement strategies is required to better align public trust with road safety goals. Current enforcement methods require reevaluation to be more effective, while communication efforts should focus on shifting motorcyclists' views of these measures from punitive to protective.

Moreover, there is a noticeable lack of confidence in local government initiatives aimed at protecting motorcyclists. Only 20% of respondents feel that the mayor's office is genuinely committed to saving the lives of motorcyclists, highlighting a disconnect between authorities and road users. In fact, drivers consider ~~this~~ traffic deaths a major problem (Figure 1). This suggests that without stronger government action and a shift in public perception, enforcement measures will continue to be viewed with suspicion, and educational efforts will be favored as the primary path to improving road safety.

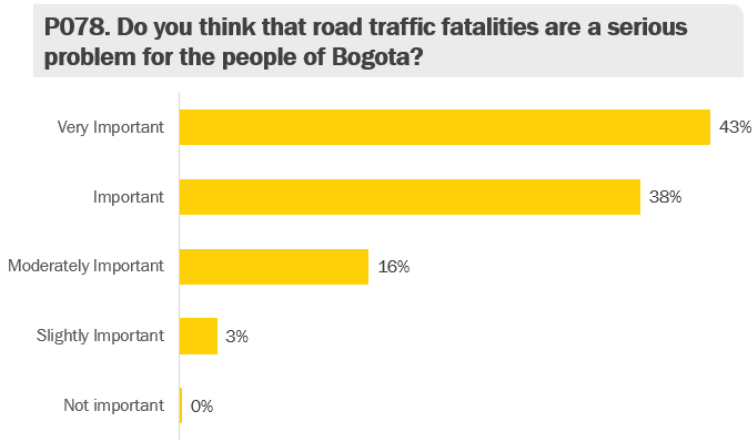

Figure 1. Importance of road traffic fatalities among users

Risky Driving Behavior

Age significantly influences risky riding behaviors, with younger riders consistently engaging in more dangerous practices. Younger riders are significantly more likely to listen to music or talk on the phone while driving their motorcycle (Δ Mean = -0.824 ***), to drive as fast as others let them (Δ Mean = -0.515 ***), and to enjoy going faster than others (Δ

Mean = -0.474 ***). These behaviors directly increase the risk of crash and suggest a lower perception of danger among younger riders.

Gender has a less pronounced, but still notable impact on risky riding behaviors, with males showing a slightly higher tendency towards certain risks. Male riders are significantly more likely to enjoy going faster than women (Δ Mean = 0.288 *) and to break traffic rules in places where other motorcyclists do it (Δ Mean = 0.252 *). However, for some behaviors like listening to music or talking on the phone while driving (Δ Mean = -0.043) and driving as fast as others allow (Δ Mean = 0.179), the gender differences are not statistically significant.

Disconnection Between Confidence, Risk Perception, and Risk-taking Behaviors Among Motorcyclists

- **Confidence in abilities:** Motorcyclists often exhibit a high level of confidence in their skills, with many believing they can handle challenging or unexpected situations. A significant portion of riders feel equipped to manage unforeseen circumstances even on unfamiliar roads. Similarly, many believe they possess the necessary skills to avoid crashes in hazardous situations, while others consider themselves to be expert motorcycle drivers. This elevated confidence in their abilities plays a crucial role in shaping their behavior, potentially leading to riskier decision-making on the road.
- **Outcomes and incident rates:** This confidence in abilities, however, does not always prevent incidents. From the survey, a substantial number of motorcyclists have reported falling off their motorcycles at least once, with others receiving traffic fines, mostly related to speeding. Collisions are also a common occurrence among riders, with many involved in at least one event over the same period. These statistics reveal a gap between perceived control and actual safety, showing that despite their confidence, motorcyclists are often involved in dangerous situations.
- **Disconnect between risk awareness and personal risk perception:** A disconnect exists between motorcyclists' awareness of general riding risks and their perception of personal vulnerability. While riders acknowledge the inherent dangers of motorcycling, their confidence and overestimation of their abilities often lead them

to downplay their own risk. For instance, despite the enjoyment of higher speeds and the perceived necessity of lane-splitting, these behaviors contribute to the increased rates of falls, fines, and collisions. This disconnect highlights the need for targeted safety interventions that encourage riders to apply their general risk awareness to their personal riding practices.

Analysis

Models

Regression models are statistical tools used to explore the relationships between a dependent variable and one or more independent variables. These models help in predicting outcomes and understanding which factors significantly impact the dependent variable. Figure 2 presents the correlation between variables of interest to be analyzed and explained by models.

"During the last 2 years of motorcycling in Bogotá, have you..."

- 84 Number of traffic citations/tickets
- 85 Number of falls (alone)
- 86 Number of collisions with a fixed object
- 88 Simple collision (without injuries)
- 90 Collision with serious injuries
- 91 Collision with fatalities

	P084	P085	P086	P088	P090	P091
P084	1,000	0,235	0,207	0,205	0,270	0,239
P085	0,235	1,000	0,264	0,272	0,162	0,142
P086	0,207	0,264	1,000	0,475	0,621	0,657
P088	0,205	0,272	0,475	1,000	0,612	0,575
P090	0,270	0,162	0,621	0,612	1,000	0,895
P091	0,239	0,142	0,657	0,575	0,895	1,000

Figure 2 Correlation between different variables of interest

Below is an explanation of models used to predict different traffic related outcomes

- **Model 1: Predicting number of traffic fines**

  This model predicts the number of traffic fines based on four key variables (Figure 3)

  - **Frequency of motorcycle driving (P004):** Motorcyclists who ride more frequently are more likely to incur traffic fines.

- **Gender (P005):** Males are statistically more likely to receive fines compared to females.
- **Motorcycle ownership (P115**): Although not statistically significant, owning a motorcycle slightly reduces the likelihood of receiving fines compared to borrowing one.
- **Excessive noise (P114_2):** Motorcycles with louder exhausts are associated with more fines.

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.07160    0.40569  -0.176 0.859998
P004         0.33014    0.09924   3.327 0.000959 ***
P005         0.54108    0.11929   4.536 7.55e-06 ***
P115        -0.46260    0.25363  -1.824 0.068899 .
P114_2       1.17768    0.27641   4.261 2.53e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.075 on 410 degrees of freedom
  (4 observations deleted due to missingness)
Multiple R-squared:  0.108,     Adjusted R-squared:  0.09927
F-statistic: 12.41 on 4 and 410 DF,  p-value: 1.556e-09
```

Figure 3. Model 1: Predicting Number of Traffic Fines

- **Model 2: Predicting number of traffic fines**

  This model examines how certain attitudes and behaviors predict traffic fines among motorcyclists (Figure 4):

  - **Attitude toward right versus wrong (P027):** Motorcyclists who believe that if something works, it doesn't matter if it's done right or wrong, tend to have a slight increase in fine
  - **Self-assessed expertise (P044):** Motorcyclists who consider themselves experts tend to incur more fines, suggesting possible overconfidence in their abilities.
  - **Distractions while driving (P059):** Listening to music or talking on the phone significantly increases the likelihood of receiving fines.
  - **Breaking traffic rules in group settings (P064):** Motorcyclists who are influenced by the behavior of others are more likely to receive fines.

- **Perceived safety (P073):** Riders who feel less safe at higher speeds tend to have fewer fines, potentially indicating more cautious behavior.

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.17485    0.32257  -0.542  0.58807
P027         0.07829    0.04632   1.690  0.09175 .
P044         0.14603    0.05648   2.586  0.01006 *
P059         0.12080    0.04125   2.928  0.00360 **
P064         0.16369    0.05442   3.008  0.00279 **
P073        -0.09965    0.04497  -2.216  0.02723 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.101 on 413 degrees of freedom
Multiple R-squared:  0.1119,    Adjusted R-squared:  0.1011
F-statistic:  10.4 on 5 and 413 DF,  p-value: 2.05e-09
```

Figure 4. Model 2: Predicting Number of Traffic Fines

- **Model 3: Socio-demographic factors influencing crash severity**

  This model investigates how demographic factors impact the severity of crashes (Figure 5):

  - **Dependent variable:** In the last two years, involved in traffic crash, that resulted in a …
    - 0: No collision
    - 1: Minor collision (no injuries)
    - 2: Collision with minor injuries
    - 3: Collision with serious injuries or Collision with fatalities
  - **Independent variables:**
    - **Age (P006):** Older individuals tend to be involved in less severe crashes. This suggests that as people age, they may drive more cautiously, resulting in less severe outcomes.
    - **Primary transportation means (P008):** Those for whom motorcycles are their primary mode of transport show a positive association with crash severity. This could indicate that frequent use of motorcycles increases exposure to higher risk.

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.745157   0.204282   3.648 0.000298 ***
P006        -0.015252   0.004401  -3.466 0.000584 ***
P008         0.230765   0.136204   1.694 0.090964 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.771 on 416 degrees of freedom
Multiple R-squared:  0.03538,   Adjusted R-squared:  0.03074
F-statistic: 7.629 on 2 and 416 DF,  p-value: 0.0005575
```

Figure 5. Model 3: Socio-Demographic factors influencing crash severity

Model 4: Personality traits influencing crash severity

This model explores the relationship between personality traits and crash severity (Figure 6):

- **Risk-taking attitudes (P031, P045, P057):** Traits related to enjoying speed, taking risks, and bending rules for safety are associated with higher crash severity.
- **Perception of speed and safety (P035, P049):** Riders who believe high speed saves time or that empty roads reduce risk are more likely to be involved in serious crashes.

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.03148    0.09572   0.329   0.7424
P054         0.11981    0.03040   3.941 9.53e-05 ***
P045         0.05973    0.03365   1.775   0.0766 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.764 on 416 degrees of freedom
Multiple R-squared:  0.05302,   Adjusted R-squared:  0.04846
F-statistic: 11.64 on 2 and 416 DF,  p-value: 1.2e-05
```

Figure 6. Personality traits influencing crash severity

Model: predicting crash severity

The integrated model combines societal and personal factors to predict crash severity (Figure 7 and Figure 8):

- **Age (P006) and primary mode of transportation (P008):** Older riders and those who frequently use motorcycles are at different levels of crash risk.
- **Traffic rule adherence (P054):** Riders who feel that strict traffic rules diminish the motorcycle's speed advantage are more prone to severe crashes.

```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.382921   0.221593   1.728 0.084726 .
P006        -0.011883   0.004415  -2.692 0.007400 **
P008         0.226102   0.133970   1.688 0.092219 .
P054         0.115944   0.029912   3.876 0.000123 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7584 on 415 degrees of freedom
Multiple R-squared:  0.06908,   Adjusted R-squared:  0.06235
F-statistic: 10.27 on 3 and 415 DF,  p-value: 1.563e-06
```

Figure 7. model: predicting crash severity - 1

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.26397    0.18468   1.429  0.15366
P106        -0.11284    0.03937  -2.866  0.00437 **
P008         0.23803    0.13376   1.779  0.07590 .
P054         0.11926    0.02962   4.027 6.73e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7575 on 415 degrees of freedom
Multiple R-squared:  0.07121,   Adjusted R-squared:  0.0645
F-statistic: 10.61 on 3 and 415 DF,  p-value: 9.86e-07
```

Figure 8. model: predicting crash severity - 2

Results of the qualitative study

The focus group discussions revealed important insights into motorcyclists' perceptions of risk, safety behaviors, and the factors that influence their driving decisions, as presented in the findings below. As a supplement to the quantitative study, the focus groups offer a deeper understanding of how motorcyclists manage perceived dangers on the road and the ways in which their experiences and beliefs shape their approach to situations.

Main takeaways

- The very reasons people choose motorcycles (speed, agility, time-saving) are closely tied to risky behaviors.
- A paradox exists between rational understanding and emotional behavior regarding speed limits. A vast majority of the participants in the focus groups know and understand the limits but often can't emotionally adhere to them and there's a significant gap between the normative (legal) speed limit and the internal speed limit that riders set for themselves based on their perceived skills.
- The current climate among drivers of low understanding of the problem, distrust[6] in enforcement (cameras), and lack of confidence in authorities has brought motorcyclists to a dangerous way to increasing safety awareness: having a crash event (so-called "traumatic events") has been identified as a primary means of changing behavior.
- Many motorcyclists view enforcement negatively, seeing it as persecution rather than protection, which undermines trust in authorities and increases resistance to safety regulations, and use of routing apps to be warned on the location of cameras.
- Educational initiatives, especially those led by experienced motorcyclists (e.g. Angie Pangie), are preferred over punitive measures, with suggestions for on-road education through radar and more training opportunities.

Meanings/Connotations associated with being a biker

According to the focus group analysis, it was identified that motorcycles carry a variety of meanings and connotations for their users, which can generally be grouped into two categories: rational and emotional. Rational meanings often relate to practical and economic considerations, such as time, cost, and convenience. Emotional meanings, on the other hand, encompass the feelings and personal empowerment associated with being a biker. Table 3 presents both sets of meanings to illustrate the diverse factors that make motorcycles

[6] Cameras are regularely calibrated for accuracy in the speed measurement. The distrust is in regard the purpose.

appealing to different people, from the efficiency of transportation to the sense of freedom and community experienced on the road.

Table 3. Meanings/Connotations associated with being a biker

Rational meanings	
1	Agility
2	Time saving
3	Comodidad (comfort, vs. public transport)
4	Money saving (vs. public transport, also no tolls, no plate restrictions)
5	Accessibility (within budget for both purchase and maintenance)
Emotional meanings:	
1	Freedom
2	Independence
3	Autonomy
4	Peace / calm (+ on highway)
5	Community: there is brotherhood on the road. Tips, advice are shared, casualties are reported, etc.
6	Adrenaline (+ young people and women)
8	Empowerment (+ in women)

Motorcycles hold diverse meanings for their users, spanning both rational and emotional aspects. These dual appeals illustrate why motorcycles are embraced by a wide array of people, each finding their own value in the experience of riding.

Risk perception

In general, motorcyclists often see the biggest risks on the road as coming from external factors rather than their own behavior. They usually consider road conditions, like potholes and missing manhole covers, along with the weather and the recklessness of other road users (cyclists, pedestrians and vehicles) as the main dangers. Interestingly, they're less likely to acknowledge speeding or their own recklessness as major risks, though delivery workers are somewhat more aware of these issues.

Despite this external focus, riders believe they can manage these risks through their own skills, actions, and experience. They rely on their expertise to navigate dangerous situations and feel confident in their ability to avoid crashes. However, much of their effort is directed

at avoiding law enforcement rather than the risks themselves. For example, riders are often aware of speed camera locations, avoid police checkpoints, and use their road knowledge to steer clear of encounters with authorities, rather than focusing on safer driving behaviors.

Awareness of risks (risky behaviors) about speed, alcohol and helmet use

Awareness of risky behaviors among motorcyclists varies significantly across different actions. Helmet use has the highest level of awareness, with strong internalization and social consciousness. This result aligns with a study conducted by Universidad de los Andes and Johns Hopkins University, which showed that 98% of motorcyclists in Bogotá use helmets. It's easy to enforce and widely accepted, as riders understand its critical importance, viewing themselves as "the chassis" of the motorcycle, which highlights their vulnerability. Awareness about the dangers of drinking and driving is moderate to high; most riders recognize its potentially fatal consequences, though some still allow for small amounts of alcohol. Speeding, however, has the lowest level of risk awareness, particularly among younger male riders.

Motorcyclists demonstrated a wide variety of ways they believe they can control risks on the road, that reflect a strong belief in their ability to manage dangers through personal skill and knowledge, rather than adhering to speed limits or other traffic regulations. They rely heavily on their own abilities and expertise, confident that their experience can keep them safe. Familiarity with frequently traveled roads allows them to anticipate hazards like potholes, and many practice predictive driving, always anticipating the actions of other road users. Staying alert and maintaining their motorcycles through regular upkeep are also key strategies. Some riders even choose isolation, intentionally avoiding interaction with other road users to reduce potential risks.

The findings from the focus groups show that risk-taking behavior tend to increase during the first two years of riding, reaching its peak during what is known as the "full fever" stage. However, this tendency often decreases after rider’s experience "traumatic events" or undergo significant life changes. The findings from Target Insights® show that despite widespread advertising campaigns showcasing the crashes and bad experiences of others, focus group findings suggest that "nobody learns from others' experiences." Personal,

firsthand encounters with danger are far more effective in changing riders' behavior. This is synthesized in Figure 9.

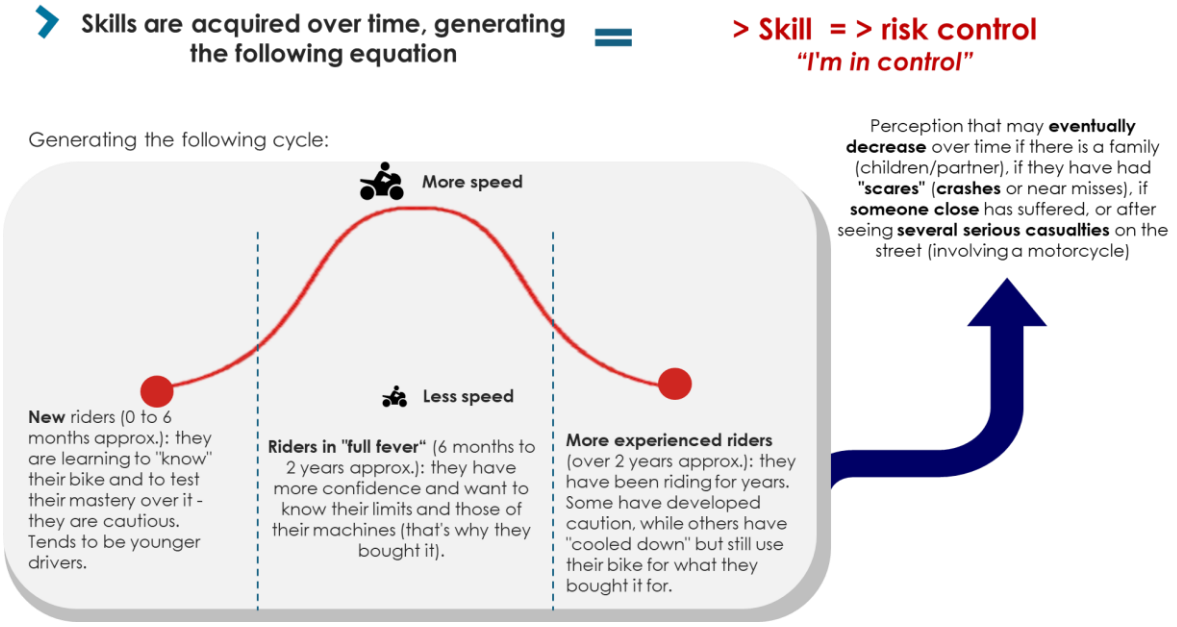

Figure 9. Cycle of changes of awareness of risk. Source: Target Insights®.

Speed

Motorcyclists value speed as a primary advantage of their chosen mode of transport, yet this creates a complex relationship with safety regulations. A paradox exists where a big number of participants in the focus groups rationally understand speed limits but emotionally struggle to adhere to them. This conflict manifests in a substantial gap between regulatory speed limits and riders' internal speed limits. These self-imposed limits are not fixed, fluctuating based on factors such as road conditions, time of day, and traffic density. Notably, speeding demonstrates the lowest level of risk awareness among risky behaviors, particularly in younger male riders. This low awareness, combined with various conditions that either promote speeding or encourage slowing down (as detailed in **Error! Reference source not found.**), creates a challenging environment for promoting road safety among motorcyclists. The dynamic nature of these internal limits and the factors influencing them underscore the complexity of addressing speeding behavior in this population.

The conditions and reasons that leads to speeding:	
1	Being in a hurry
2	When there are unoccupied roads (low flow of other road users)
3	“Everyone does it, everyone drives fast”
4	It may even be more dangerous to go slow (cars honk and push them to drive over the limit)
5	At night: for security reasons and because the roads are clearer (they can go up to 100km/h)
The conditions and reasons that lead to slow down:	
1	Having experienced "scares," crashes, or incidents (falls)
2	Going with a passenger: the sense of responsibility increases when carrying a passenger
3	Reminders on the road: thinking about family, seeing a crash, etc.

Table 4. Meanings/connotations associated with being a biker

Increase awareness

Focus groups identified that motorcyclists' awareness of road risks is shaped by three main factors: personal "traumatic events," the influence of experienced peers, and contextual reminders encountered while riding motorcycle. The impact of these factors varies with experience, from novice riders (0-6 months) to those in the "full fever" stage (0.5 to 2 years), and long-term riders (over 2 years). This calls for targeted strategies for each group.

Actions suggested by interviewees to broaden and shift awareness include:

1. Shifting the mindset around enforcement, as many motorcyclists feel persecuted by the police.
2. Promoting civic responsibility, replacing fines with social sanctions or activities for traffic violations.
3. Enhancing signage or identifiers on motorcycles for those who don't want to be influenced by bad practices.

Currently, having experienced "traumatic events" remain the primary driver of awareness, an unsustainably high cost for safety education. This underscores the urgent need for proactive, less harmful approaches to foster risk awareness in the motorcycling.

Main findings of the study

The study provides critical insights into the behavior, perceptions, and practices of motorcyclists in Bogotá, particularly younger riders. A significant portion (46%) of riders learned to ride informally, leading to concerns about safety and skill levels. Although 81% recognize the seriousness of traffic fatalities, only 20% believe they are personally at risk, indicating a disconnect between general and personal risk perception. Younger riders are more prone to risky behaviors, like speeding and rule-breaking, driven by sensation-seeking tendencies. Interestingly, motorcyclists prefer educational approaches to road safety over punitive measures, signaling a need for more learning-focused interventions.

The study also highlights that age plays a more significant role than gender in shaping attitudes and behaviors. Younger riders consistently show more permissive attitudes towards speeding, drink driving, and traffic rule violations compared to older riders. For example, younger motorcyclists justify speeding and minor traffic infractions more easily, viewing motorcycles as tools for agility and speed. This group is more likely to believe that breaking traffic laws is necessary for navigating the city, reflecting a higher tolerance for risky behavior. Table 3 presents the main common or similar finding from both studies.

Factor	Description
Age-related differences in risk behavior	Younger riders (18-29) consistently show higher propensity for risky behaviors, thrill-seeking, and disregarding norms compared to older riders.
Complex relationship with speed limits	Riders understand speed limits rationally but struggle emotionally to adhere to them, creating a gap between legal and self-imposed limits.
Disconnect between risk awareness and personal behavior	Riders show high awareness of general risks but low perception of personal risk, leading to continued engagement in risky behaviors.
Importance of personal experiences in changing behavior	Riders often only change behavior after experiencing "traumatic events" or significant personal negative experiences while riding.
Influence of peer groups and community	The motorcycling community plays a significant role in shaping attitudes and behaviors, with experienced riders potentially influencing others.
Low perception of speeding as a risky behavior	Speeding is not widely recognized as a significant risk, particularly among younger riders, despite its potential dangers.

Motivations for motorcycle use	Common reasons include time-saving, agility, freedom, independence, and cost-effectiveness compared to other transportation modes.
Overconfidence in riding abilities	Many riders, especially males, display high confidence in their skills, often overestimating their ability to handle risks.
Skepticism towards enforcement	Motorcyclists view enforcement negatively, perceiving it as persecution rather than protection, leading to resistance and distrust.

Table 5 Similarities of qualitative and quantitative studies

Finally, the qualitative results reveal that motorcyclists see external factors like poor road conditions as the biggest risks, rather than their own behavior. There is a high level of awareness regarding helmet use, but less so for speeding, especially among younger males. Riders rely on their personal skills to manage risks, and their risk-taking behaviors often decrease after personal experiences with crashes. Despite this, educational initiatives, especially from experienced riders, remain more popular than enforcement measures, reflecting a distrust in authorities and enforcement mechanisms.

Recommendations

Consider aligning enforcement with opportunity to convey educational messages, while generating trust in authorities (a win-win). If some drivers do not fully understand the situation, plus they view the use of cameras as a business, they could feel enforcement as an unfair, senseless, or punitive measure. One approach could be a joint effort with the authorities, influencers, and stakeholders to develop a strategy, where the message of negative impacts of speeding is conveyed by a slogan such as “we don´t want your money, we want you to be safe”. The strategy could temporally reframe enforcement, from charging fines to an on-road educational opportunity. Create "safety checkpoints" that offer interactive learning experiences, personalized safety tips, and incentives for participation. This approach aims to leverage riders' preference for educational measures, address skepticism towards current enforcement strategies, and foster a culture of responsible riding through positive engagement with authorities.

The survey and the focus groups (Figure 9) reveal significant age-related differences (18-29 age group) across multiple domains, including personality traits (sensation seeking, normlessness), attitudes (toward speeding and traffic rules), risk behaviors (such as speeding and using a phone while driving), perceptions (of risk and personal driving skills), justification for rule-breaking, views on safety measures, driving confidence, and alcohol-related attitudes. Given these widespread age-based differences, a targeted advertising campaign could be highly effective in addressing the specific concerns and behaviors of younger riders.

Prioritize younger riders, given the significant differences in behavior and attitudes in the 18-29 age group, with a focused advertising campaign that addresses their specific tendencies, such as sensation seeking and risk-taking. This campaign should challenge risky behaviors like speeding and the use of mobile phones while driving.

Communication strategies

- **Leverage motorcyclists' community influence**: Given the strong recognition of social media influencers that are motorcyclists, conveying messages through them can be an effective strategy. Engaging these figures can help shape positive behaviors within the riding community.
- **Combine preventive and on-the-road messaging:** A mixed communication approach that includes both preventive campaigns and on-the-road reminders (such as visual markers of crash-prone areas) will reinforce motorcyclists' sense of vulnerability. These reminders can serve as a constant reinforcement of safety precautions.
- **Challenge overconfidence and promote realistic risk perception:** Many motorcyclists overestimate their skills and underestimate risks. A campaign featuring interactive simulations and real-life scenarios could demonstrate how overconfidence can lead to dangerous situations, encouraging riders to adopt a more realistic risk assessment approach.

Enforcement and education approaches

- **Implement on-site speeding education:** Develop enforcement mechanisms that focus on educational outcomes rather than punitive measures. For example, implementing on-road speeding controls, where riders receive educational content instead of fines. That can help to transform and shift negative perceptions of enforcement and promote long-term behavioral changes. Introduce safety checkpoints where riders can receive personalized safety advice, participate in interactive learning experiences,
- **Revise and evaluate current outcome of fines:** In Bogotá, traffic violators must take an educational course to receive a discount on their fines. However, it's unknown whether these courses are effective or if they convey the desired message. The quality of these educational spaces could be reviewed and potentially redesigned.
- More consistent and visible enforcement across various traffic violations to increase deterrence.

Legal and policy recommendations

- **Special laws for young motorcyclists**: Advocate in the Congress of the Republic for the modification of laws to create special licensing mechanisms for motorcycle driving permits, with specific requirements for new motorcyclists (focused to young or inexperienced motorcyclists).
- **Abolish the wavier for driving lessons and increase the number of hours**: This measure is directed to fix the "learning by experience" phenomena.
- **Incentives**: Create insurance incentives for motorcyclists who have not been involved in crashes or traffic incidents.
- **Promote legal frameworks for responsible speeding behavior:** Legal policies should address the core motivations for speeding by promoting responsible behavior. While acknowledging the benefits of motorcycle use, such policies should also set realistic expectations and encourage adherence to safety regulations through positive reinforcement mechanisms.

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