

BEHAVIOURAL COMMUNICATION IN MOTORCYCLE TRAFFIC: MALAYSIAN EVIDENCE AND POLICY IMPLICATIONS

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Abstract. Motorcycle traffic dominates mobility in many Southeast Asian cities, yet road safety policy continues to emphasise infrastructure, enforcement, and formal signalling systems. This study examines the role of informal behavioural communication in everyday motorcycle traffic interaction in Malaysia. Using survey evidence from 840 motorcycle riders, supported by enforcement practitioner insights and comparative observations from selected Asian contexts, the research analyses how riders communicate intention, negotiate space, and manage uncertainty in dense mixed traffic conditions. The findings show that riders frequently rely on a set of informal interaction practices including hand gestures, head nodding, brief horn signals, and empathetic yielding. Among these behaviours, yielding and visual acknowledgement emerge as the most prevalent coordination strategies. Respondents strongly associate these practices with reduced misunderstanding, smoother traffic flow, fewer near miss incidents, and stronger perceived safety and confidence while riding. Inferential analysis further indicates that the perceived safety value of these communication practices is consistent across study locations. The study argues that road safety should be understood not only as a regulatory and infrastructural challenge but also as a behavioural communication process embedded in traffic culture. Integrating behavioural communication awareness into rider education, safety campaigns, and policy design may strengthen preventive road safety strategies and contribute to SDG 3 Good Health and Well-Being, particularly in reducing traffic accidents and improving public health outcomes in urban mobility systems.

Keywords: *behavioural communication in traffic, motorcycle safety, informal traffic interaction, road safety policy, good health and well-being*

Introduction

Road safety remains a major public health concern worldwide. The World Health Organization estimates that road traffic crashes cause approximately 1.19 million deaths each year, with more than half involving vulnerable road users including pedestrians, cyclists, and motorcyclists (WHO, 2023; 2026). This burden falls disproportionately on low and middle income settings, where rapid motorisation, mixed traffic conditions, and uneven enforcement create compounding risk for road users. Malaysia reflects this challenge sharply. The Malaysia Road Safety Plan 2022 to 2030 places road safety within a Safe System framework and targets a 50 percent reduction in road deaths by 2030. The plan emphasises education, behavioural change, and multi-stakeholder coordination as core pillars of intervention (MTM, 2022; 2026). Yet the continuing

prominence of motorcycles in everyday Malaysian mobility means that approaches centred mainly on infrastructure and enforcement do not fully capture the lived interactional realities of traffic.

What matters here is the nature of traffic as a social environment. Road use is not governed solely by signs, lane markings, and legal rules. It is shaped by informal micro-communication among road users. In dense and fluid conditions, riders and drivers routinely rely on brief hand signals, eye contact, head movements, short horn taps, and yielding behaviour to communicate awareness, intention, and courtesy. Research on road user interaction has shown that nonverbal cues remain central to how people interpret risk and negotiate movement in real time (Onkhar et al., 2022; Rasouli et al., 2017). This study examines precisely that neglected dimension. The core argument is that informal behavioural communication among Malaysian motorcycle riders is patterned, widespread, and meaningfully linked to perceived safety outcomes. The study does not seek to replace formal road safety measures. It seeks to explain an under-examined behavioural layer of everyday traffic coordination and to consider whether that layer deserves explicit attention in rider education and policy design.

Research questions and objectives

The study addresses four questions. First, what forms of informal behavioural communication are most commonly used by motorcycle riders in Malaysia? Second, how do Malaysian patterns compare with selected Asian traffic cultures? Third, to what extent are informal communication practices associated with perceived safety, reduced misunderstanding, and lower near-miss exposure? Fourth, what are the implications of these findings for road safety education and policy in Malaysia? Four corresponding objectives guide the investigation: to identify dominant forms of informal communication among Malaysian riders; to situate Malaysian practice within a broader regional traffic culture through comparison; to evaluate the relationship between informal interaction and rider safety perceptions; and to generate policy-relevant insights for integrating behavioural communication into road safety training and intervention design.

Literature review

Motorcycle safety research has documented the heightened vulnerability of powered two-wheelers, particularly in countries where motorcycles are deeply embedded in urban transport. The global evidence shows that risky riding behaviour, poor hazard anticipation, and socially disruptive manoeuvres are associated with crash risk among motorcyclists (Sagala et al., 2025). Research in heterogeneous traffic settings further shows that rider behaviour is shaped by surrounding density, situational pressure, and context-specific decision-making rather than formal rule knowledge alone (Chakraborty and Chatterjee, 2024). Behavioural communication refers to the informal, often nonverbal cues through which road users signal awareness, intention, caution, permission, appreciation, or urgency. These signals do not replace formal traffic controls but supplement them when road users must make rapid judgements about one another's likely actions. Rasouli et al. (2017) argue that road users routinely rely on subtle behavioural cues to reach mutual understanding in dynamic traffic contexts. Dey et al. (2021) found that road users interpret a wide range of implicit signals through movement, positioning, and gaze, even in the absence of explicit verbal communication.

These findings are especially relevant in motorcycle traffic, where interactions are close-range, fast-moving, and often only partially regulated by formal infrastructure.

Hand signals remain one of the clearest forms of behavioural communication in road traffic. At intersections and during lane change situations, informal gestures can convey yielding intention, appreciation, or caution in dense conditions where riders need immediate acknowledgement. Ariffin et al. (2020) documented inconsistencies in formal indicator use among Malaysian motorcyclists, suggesting that riders do not rely on mechanical signals alone. Leong et al. (2021) showed that unsignalised intersections are especially sensitive to risky riding behaviour, reinforcing the importance of supplementary communicative clarity. Horn use is often treated in road safety discourse as inherently aggressive. The evidence is more nuanced. Nguyen et al. (2025) demonstrate that horn patterns in congested urban traffic in Ho Chi Minh City carry distinct functional meanings, including warning and presence signalling, depending on acoustic form and timing. Earlier work in Taipei similarly found that horn use at intersections can serve situational communicative functions (Tsunekawa et al., 2018). By contrast, research from Bangladesh shows that uncontrolled horn use becomes harmful when linked to anger or weak enforcement of noise regulation (Islam et al., 2024; Kabir et al., 2024). The safety value of horn use therefore depends on how it is used, not on its occurrence per se.

Visual acknowledgement is one of the most important yet least formalised dimensions of traffic safety. Onkhar et al. (2022) found that eye contact increases perceived safety among pedestrians by reducing uncertainty about another road user's awareness and intention. This insight applies strongly to motorcycle riders, whose smaller vehicle profile creates continuous uncertainty about surrounding drivers' attention. Abdul Khalid et al. (2020) showed that perceptions of motorcycle conspicuity remain a significant safety issue in Malaysia, reinforcing the idea that being seen and acknowledged are fundamental safety processes. Yielding behaviour has a social dimension beyond formal traffic rules. In mixed traffic, giving way communicates courtesy, recognition, and cooperative intent. Yu et al. (2023) found that altruism is positively associated with prosocial driving and yielding behaviour. Ren et al. (2019) conceptualise effective traffic behaviour around empathy and anticipation, meaning that safe movement involves reading the needs and probable intentions of others rather than asserting priority alone. This literature supports reading empathetic yielding as a safety mechanism that operates through cooperation and reduced friction in shared road space.

Road safety outcomes are shaped not only by laws and enforcement but also by values, norms, and routine expectations. Nævestad et al. (2022) argue that road users' values toward risk and freedom influence accident risk, which implies that safety behaviour is partly embedded in broader normative systems. If riders routinely operate in a traffic culture where certain gestures, horn patterns, or yielding practices are widely recognised, those behaviours become part of the local safety order. They function as learned norms that reduce uncertainty because participants share at least partial understanding of their meaning. Three theoretical strands are particularly useful for interpreting the present study. The theory of planned behaviour suggests that attitudes, perceived norms, and perceived control influence behavioural intention and actual conduct (Forward, 2009; Ajzen, 1991). Interaction ritual theory helps explain how repeated face-to-face encounters generate predictable behavioural patterns through mutual attention and shared situational cues (Goffman, 2017). Road safety culture theory highlights the role of norms, values, and accepted practices in shaping safety

outcomes (Nævestad et al., 2022). Together, these perspectives support the article's core claim that behavioural communication in motorcycle traffic is socially patterned, meaningful, and policy relevant.

Materials and Methods

The study adopted a mixed methods design with a quantitatively dominant structure and an embedded qualitative-comparative component. A single method would not have been sufficient. The research questions required descriptive evidence on the prevalence of informal interaction, comparative evidence on how Malaysian practices relate to other Asian traffic cultures, and inferential evidence on whether these practices are associated with perceived safety outcomes. This logic reflects a pragmatic mixed methods orientation where design is driven by the problem and the type of evidence required (Tashakkori and Teddlie, 2010). Data were collected from motorcycle riders at multiple locations in Malaysia spanning urban and suburban environments. A total of 840 valid rider responses were retained for analysis. The sample was drawn using purposive and convenience sampling procedures at traffic observation points, motorcycle parking areas, and public spaces where riders were accessible. In addition to the rider component, enforcement officers were surveyed to provide an institutional perspective on informal traffic interaction. A thematic cross-country comparison was also conducted, drawing on published literature and observational accounts from Malaysia, Indonesia, Vietnam, and Bangladesh.

The rider survey included items covering four main domains of informal communication: hand gestures, polite horn use, visual acknowledgement, and empathetic yielding. Each domain was measured using Likert-scaled items capturing frequency of use and perceived effectiveness. Additional items measured perceived safety outcomes including misunderstanding avoidance, near-miss exposure, accident avoidance, traffic flow, and psychological states including confidence, calmness, comfort, and stress reduction. A polite horn sub-study collected data on the timing, type, situational context, and emotional consequences of horn use from a subset of 253 riders who reported using the horn during the study period. Descriptive statistics including frequencies, means, and percentage distributions were calculated for all main variables. Inferential analysis used one-way ANOVA and Welch's ANOVA to test whether perceived effectiveness of informal interaction and perceived safety differed across study locations. Prior to inferential testing, normality was assessed using Kolmogorov-Smirnov and Shapiro-Wilk tests. Levene's test was applied to check homogeneity of variance; Welch's procedure was used where homogeneity was not met. A chi-square test examined the association between short horn use and accident avoidance perception. Given the large sample of 840, deviations from normality were addressed under the central limit theorem, following established guidance (Pallant, 2020; Field, 2018).

Results and Discussion

Communication practices among riders

Table 1 presents the mean scores for the principal forms of informal behavioural communication reported by riders across four domains. The results show that visual

acknowledgement through head nodding and empathetic yielding recorded the highest mean values, while hand signals for lane change were more moderate. Across all categories, cooperative and relational practices were stronger than purely directional or technical signals. The pattern here is important. Riders did not distribute their communicative effort evenly across all signal types. Courtesy-oriented and accommodation-based behaviours dominated, suggesting that the informal communication system in Malaysian motorcycle traffic is primarily relational rather than technical. Riders communicated acknowledgement and goodwill more consistently than they communicated directional intention through gesture.

Table 1. Mean scores for informal communication practices.

Communication practice	Mean score (1 to 5)
Hand signal for lane change	3.42
Hand signal for giving way	3.68
Hand signal for appreciation	3.71
Short polite horn signal	3.59
Head nodding or visual acknowledgement	3.89
Empathetic yielding (slowing, giving way)	3.94

Perceived effectiveness of informal interaction

Table 2 shows descriptive statistics for rider evaluations of informal interaction effectiveness. All five items recorded mean scores above 3.7 on a five-point scale, indicating consistent positive evaluation across the sample. The highest means were recorded for improving traffic flow and supporting formal training modules. More than two-thirds of respondents agreed or strongly agreed that informal interaction helps avoid misunderstanding. Over 80 percent agreed or strongly agreed that it improves traffic flow. Nearly three-quarters supported its inclusion in formal training. These results indicate that riders do not view informal communication as peripheral to road safety. They regard it as a practical and institutionally relevant resource.

Table 2. Descriptive statistics for effectiveness of informal interaction.

Item	Mean
Making traffic more orderly	3.77
Avoiding misunderstanding	3.84
Contributing to safety	3.85
Improving traffic flow	4.10
Supporting formal training modules	4.06

Safety-related outcomes

Table 3 summarises rider responses on four safety-related outcomes. Across all four indicators, riders reported a positive relationship between informal communication and both objective and psychological dimensions of safety. The summary table for perceived safety (Table 4) consolidates four psychological indicators and shows that all mean scores ranged between 4.06 and 4.22, with calmness during interaction recording the highest value. These findings indicate that the safety value attributed to informal communication extends well beyond traffic coordination. Riders consistently associated these practices with a more regulated emotional experience on the road.

Table 3. *Safety-related outcomes associated with informal communication.*

Safety outcome	Agree/strongly agree (%)
Rarely experience near misses	67.6
Helping avoid accidents	72.2
Feeling more confident during interaction	77.5
Feeling comfortable sharing the road	82.3
Feeling calmer during traffic interaction	83.8
Experiencing less stress while riding	77.6

Table 4. *Overall perceived safety indicators linked to informal communication.*

Variable	Mean (N = 840)
More confident during interaction	4.06
Comfortable sharing the road	4.18
Calmer during interaction	4.22
Less stress while riding	4.08

Inferential tests

Normality tests showed that residuals deviated from strict normality, which was expected given the sample size and Likert-scaled responses. With a sample of 840, analysis of variance remains appropriate under the central limit theorem when interpreted carefully (Pallant, 2020). Levene's test showed that homogeneity of variance was met for the general effectiveness variable and the perceived safety using informal signals variable, but not for the polite interaction variable; Welch's ANOVA was applied in that case. The ANOVA results for perceived effectiveness across study locations produced $F = 1.796$, $p = .167$. The ANOVA for perceived safety using informal signals produced $F = 2.147$, $p = .118$. Neither comparison reached statistical significance, indicating that rider evaluations of informal communication were broadly consistent across locations rather than concentrated in one site. This finding strengthens the external plausibility of the results by suggesting a shared pattern of behavioural communication and safety perception across the study areas. A chi-square test examining the association between short horn use and accident avoidance perception produced a chi-square statistic of 49.034 with 16 degrees of freedom and p less than .001. This statistically significant result indicates that riders who frequently use short horn signals are more likely to perceive those signals as contributing to accident avoidance, supporting the interpretation that brief horn use functions as a meaningful communicative safety mechanism.

Polite horn use: Behavioural pattern and emotional consequences

Among the 840 riders, 253 reported using the horn during the study period and provided responses to the polite horn sub-study. *Table 5* shows that the mean score for riders' emotional state before horn use was 2.86, rising to 3.67 after horn use. The reaction of other road users averaged 3.40, indicating a predominantly neutral to positive response from surrounding traffic. In terms of horn type, one short horn was used by 45.8 percent of the sub-sample and two short horns by 50.6 percent. Long or aggressive horn use accounted for only 3.2 percent of responses. Situationally, horn use was concentrated during dangerous or reckless driving by others (25.3 percent) and lane-changing without signalling (21.3 percent), with 13.4 percent attributable to asking for space during filtering. Peak horn use occurred between 7:00 and 9:59 in the morning

(39.5 percent), coinciding with the highest traffic density period. The modal emotional state before horn use was neutral, while the dominant states after horn use shifted to neutral and positive categories. These results show that polite horn use in this sample was neither anger-driven nor socially provocative. It functioned primarily as a compensatory presence signal in high-uncertainty situations.

Table 5. Descriptive statistics for polite Horn variables (N = 253).

Variable	Mean
Feeling before using the horn	2.86
Feeling after using the horn	3.67
Reaction of other road users	3.40

A structured repertoire, not improvised behaviour

The most immediate contribution of the findings is that they show informal communication to be structured rather than random. Rider data consistently clustered around four behavioural domains: hand gestures, polite horn use, visual acknowledgement, and empathetic yielding. This pattern matters because it indicates that riders do not simply improvise ad hoc responses in traffic. They draw from a recognisable repertoire of communicative practices that appear socially shared and situationally meaningful. This interpretation aligns with interaction-based approaches to traffic behaviour. Traffic movement is not governed only by formal rules. It is shaped by how road users read one another, signal intent, and anticipate reactions in real time. Rasouli et al. (2017) argue that road interaction depends heavily on communicative cues, especially where movement decisions must be made rapidly. Dey et al. (2021) show that road users often rely on implicit or semi-explicit signals when coordinating movement. The Malaysian results fit this logic closely. Riders appear to use informal communication as a practical language of road coordination.

Courtesy over direction: Why relational behaviours dominated

Not all informal practices were equally prominent. Hand gestures for lane change were moderate, while gestures for appreciation and giving way were considerably more common. Head nodding was stronger than eye contact. Empathetic yielding recorded some of the highest mean scores in the dataset. The dominant forms of informal communication were relational and cooperative rather than purely directional. This matters because it changes the interpretation. If the strongest behaviours had been directional, one might conclude that riders were compensating for inadequate formal indicators. That is only part of the story. The stronger pattern lies in appreciation, acknowledgement, and accommodation. Riders were especially likely to nod, slow down, give way, or signal thanks, suggesting that the informal system is deeply tied to the social management of traffic. Yu et al. (2023) found that altruism is positively related to prosocial driving and yielding behaviour. Ren et al. (2019) similarly argue that effective traffic behaviour involves reading the probable intentions of others rather than asserting priority. The Malaysian findings reflect both. The stronger position of head nodding over eye contact also deserves explanation. Nodding is efficient, culturally legible, and non-confrontational. Eye contact is more situational and constrained by helmet visors, speed, and angle of approach. Riders appear to prefer quick, low-effort acknowledgement cues that can be delivered without disrupting attention or control. The design of informal communication in Malaysian motorcycle

traffic is therefore pragmatic: riders select signals that are effective and feasible, not signals that are merely expressive.

The safety value of informal communication

A consistent pattern across the findings is that informal communication was strongly associated with misunderstanding avoidance, smoother traffic flow, safety contribution, and accident avoidance. The underlying mechanism appears to be ambiguity reduction. In traffic, ambiguity is dangerous because it delays response and increases misinterpretation. Riders must constantly judge whether they have been seen, whether another vehicle will give way, and whether a risk is emerging. Informal communication appears to reduce this uncertainty by making intention more legible. A nod, a brief horn tap, a slowing movement, or a hand gesture makes the behaviour of a road user easier to predict. Onkhar et al. (2022) showed that visual acknowledgement influences perceived safety because it increases certainty about another road user's awareness. Bellet et al. (2022) showed that yielding-related communication affects perceived safety and trust. The Malaysian findings extend this logic into a motorcycle-dominant setting. Riders appear to use informal communication precisely because it creates enough clarity to keep movement coordinated in situations where formal signals alone are insufficient. The study also expands the meaning of safety beyond physical outcomes. The findings show strong positive effects on confidence, comfort in sharing the road, calmness, and reduced stress. Much road safety research focuses on crashes, violations, or injuries, which are essential. Yet safety in everyday traffic is also experienced psychologically. Road users behave differently when they feel ignored, misunderstood, or threatened. They may become defensive, abrupt, or stressed. When interaction is predictable and socially intelligible, they are more likely to remain calm and coordinated. The polite horn analysis illustrates this especially well. Riders reported a more positive emotional state after using the horn than before, and other road users generally reacted neutrally or positively. Behavioural communication appears to regulate emotion as well as movement.

Consistency across locations

The inferential tests found no significant location differences for either general effectiveness of informal interaction or perceived safety using informal signals. This means that the positive evaluation of behavioural communication was relatively consistent across study sites. The finding suggests that informal traffic communication is not merely idiosyncratic to a specific city or district. It points to a broader shared pattern among Malaysian motorcycle riders. The lack of major location differences strengthens the external plausibility of the study within similar urban settings.

Enforcement recognition and institutional visibility

The enforcement findings are valuable because they show that informal communication is not visible only to riders themselves. Enforcement officers also recognised these practices in relation to tolerance, gestures, horn use, and interaction at unsignalised intersections. This institutional visibility matters. When both riders and enforcement personnel recognise similar forms of interaction, the case for behavioural communication as a real traffic phenomenon becomes stronger. It is less likely to be a self-report artefact or a narrowly subjective interpretation. It also matters for policy

translation: interventions gain traction more readily when the behaviours under discussion are already familiar to institutional actors.

Regional context

The cross-country comparison shows that auditory signals, visual acknowledgement, and gesture-based communication were present across Malaysia, Indonesia, Vietnam, and Bangladesh, though their meanings and intensity varied by context. This suggests that behavioural communication is a common adaptive feature of motorcycle-rich and mixed traffic environments, but not a universal fixed code. In Indonesia, rider behaviour is shaped by situational pressure and local traffic culture (Sagala et al., 2025; Djunaidi et al., 2024). In Vietnam, horn use and safety attitude studies show that communication and perception interact closely in dense urban traffic (Nguyen et al., 2025; Vu et al., 2023). In Bangladesh, literature demonstrates that communication practices can be either functional or harmful depending on how they are used and governed (Das et al., 2025; Islam et al., 2024). The Malaysian results fit this picture by showing a predominantly constructive form of informal interaction, especially where signals are brief, recognisable, and oriented toward coordination rather than aggression.

The study set out to examine whether informal behavioural communication contributes to motorcycle safety in Malaysia and whether such practices have relevance for road safety policy. The findings provide a clear answer. Informal communication is a regular and patterned feature of motorcycle traffic, organised around four broad domains: hand gestures, polite horn use, visual acknowledgement, and empathetic yielding. The strongest practices are relational and cooperative. Riders consistently associate these behaviours with improved traffic flow, reduced misunderstanding, greater accident avoidance, fewer near-miss situations, and stronger perceived safety. Psychological effects including increased calmness, confidence, comfort, and reduced stress are also significant. The horn-specific findings demonstrate that short horn taps dominated overwhelmingly and functioned as communicative warnings rather than aggressive acts. Enforcement officers recognised these practices, and similar interaction systems appear across selected Asian traffic contexts, though locally interpreted.

Theoretical contributions

The study contributes to theory in several respects. It extends the understanding of road safety beyond formal compliance and enforcement by showing that safety is also produced through micro-level interaction. In this study, riders used behavioural signals to make intention legible, negotiate space, and reduce ambiguity, supporting the view that traffic is not only a regulatory system but also an interactional system (Dey et al., 2021; Rasouli et al., 2017). The findings support perspectives drawn from the theory of planned behaviour, interaction ritual theory, and road safety culture research (Nævestad et al., 2022; Goffman, 2017; Forward, 2009; Ajzen, 1991). The repeated use of gestures, nodding, yielding, and polite horn signals suggests that these practices are socially learned, normatively reinforced, and mutually intelligible. They are embedded in local road culture, not random habits. The study also provides empirical evidence from Malaysia on an aspect of motorcycle safety that has received limited direct attention. Much existing literature focuses on risky riding, visibility, or crash factors (Sagala et al., 2025; Chakraborty and Chatterjee, 2024; Abdul Khalid et al., 2020). This study shows

how everyday communication practices may support safer and more stable interaction in dense traffic conditions.

Policy implications

The findings carry direct implications for road safety policy in Malaysia. First, the behavioural dimension of road safety policy needs to be broadened. Policy should not treat communication only in terms of formal indicators and compliance. It should also recognise the role of socially interpreted cues that riders use in actual traffic interaction (Onkhar et al., 2022; Dey et al., 2021; Rasouli et al., 2017). This does not mean replacing formal traffic rules with informal behaviour. It means acknowledging that real-world traffic coordination often depends on how road users interpret one another in addition to how they follow written rules. Second, selected elements of behavioural communication should be integrated into rider training and education. This could include clear acknowledgement practices such as nodding and visual confirmation, appropriate use of short non-aggressive horn signals in high-uncertainty situations, cooperative yielding behaviour in shared road space, and recognition of informal cues used by other riders and drivers (Nguyen et al., 2025; Yu et al., 2023; Onkhar et al., 2022). Such integration should be carefully framed: the purpose is to provide clearer guidance on constructive interaction that already occurs in everyday traffic, not to legitimise unsafe improvisation.

Third, road courtesy and behavioural signalling could become useful themes for public awareness campaigns. Campaigns could focus on recognising motorcycles, responding to their presence, using non-hostile communication, and reducing misunderstandings in mixed traffic (Bryden et al., 2025; Abdul Khalid et al., 2020). This approach would be especially relevant in urban areas where motorcycles and other vehicles interact closely and continuously. Importantly, unlike large infrastructure projects, these interventions can be introduced through training manuals, public messaging, and instructor guidance, making them an attractive low-cost complement to existing safety programmes. Fourth, training institutions and enforcement agencies should move closer to the real behavioural ecology of the road. For rider training, the curriculum can be expanded to include practical interaction scenarios that reflect actual road use. For enforcement, safety messaging can be refined to distinguish between courteous communication and hostile conduct. The findings from this study provide a substantive basis for both.

Limitations and future research

Several limitations should be acknowledged. The study is cross-sectional, which means the findings reflect patterns and associations at one point in time without establishing temporal causality. The rider data rely largely on self-report, which carries risks of recall bias and social desirability bias. The enforcement component was relatively small and should not be read as a statistically representative profile of national enforcement opinion. The cross-country comparison was thematic rather than based on harmonised multinational survey data, limiting its capacity for strict statistical comparison. The study does not directly measure actual crash reduction through observational or longitudinal designs. These limitations define the appropriate boundary of inference but do not weaken the main contribution. The study identifies an under-examined behavioural layer of road safety, shows that it is widespread and meaningful,

and demonstrates its policy relevance. Future research should pursue observational designs that record actual traffic interaction in real time, longitudinal work that tracks whether consistent use of constructive behavioural communication is associated with different safety trajectories, and experimental or simulation-based designs that test how riders interpret specific gestures and horn types under controlled conditions. Comparative work using harmonised instruments across countries would allow stronger testing of how traffic culture shapes the meaning and effectiveness of informal communication. Policy evaluation studies should also assess whether incorporating behavioural communication content into training or awareness campaigns produces measurable changes in rider understanding and road behaviour.

Conclusion

Motorcycle safety in Malaysia cannot be fully understood through enforcement, infrastructure, and formal signalling alone. Riders operate in dynamic and uncertain traffic environments where behavioural communication plays a meaningful role in coordinating movement, reducing ambiguity, and shaping both physical and psychological safety (Onkhar et al., 2022; Dey et al., 2021; Rasouli et al., 2017). The evidence in this study shows that informal behavioural communication is already embedded in rider practice. It is visible in gestures, nodding, short horn use, and yielding behaviour. Riders perceive these practices as useful, safety supportive, and worthy of inclusion in training. Enforcement personnel recognise them. Similar interaction systems exist elsewhere in Asia (Sagala et al., 2025; Nguyen et al., 2025; Das et al., 2025; Djunaidi et al., 2024; Islam et al., 2024; Vu et al., 2023). Road safety policy that takes behavioural communication seriously would not replace formal traffic regulation. It would strengthen it by making policy more reflective of how road users actually interact in everyday traffic.

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Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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