REPORT OF RESEARCH RESULTS

A. Title

Analysis of Scooter Delivery Rider's Behavior in Yielding at Intersections

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C. Summary：

In recent years, the impact of COVID-19 and the rise of the home economy have contributed to the rapid growth of delivery platforms, leading to a significant increase in the number of delivery riders and establishing them as a distinct category of road users. Due to the nature of their work, delivery riders experience heightened "time pressure," making them more likely to engage in non-compliant behaviors. Recently, social discourse has increasingly focused on yielding behavior, with failure to yield being consistently identified as one of the primary causes of motorcycle accidents. To address this issue, this study referenced Article 102, Section 1 of the Road Traffic Safety Rules and employed intersection photography to observe whether motorcycle delivery riders yield at intersections. A total of 1,988 instances were recorded, and a binary logistic regression model was used to analyze factors influencing yielding behavior toward pedestrians. The results identified six significant variables affecting yielding behavior: pedestrian violations, the position of the unyielded pedestrian, the initial position of the motorcycle, the number of pedestrians, whether the rider was a delivery rider, and the number of delivery boxes carried. Additionally, a multinomial logistic regression model was applied to examine factors related to failure to yield under specific scenarios, including left turns, yielding to right-turning vehicles as required, and yielding to left-turning vehicles when entering the same lane. The analysis revealed that several variables significantly influenced failure to yield to straight-going vehicles: peak versus non-peak hours, the motorcycle’s initial position in the queue, the intended recipient of the yield, nighttime conditions, whether the rider was a delivery rider, and the placement location of the delivery box. Similarly, the factors influencing failure to yield to right-turning vehicles included peak versus non-peak hours, the initial position of the motorcycle in the queue, the intended recipient of the yield, and whether the rider was a delivery rider.

D. Aim of Research

With the increase in delivery orders, the number of delivery riders has also been steadily rising, from 45,000 in 2019, 87,000 in 2020, 102,000 in 2021, 155,000 in 2022, to 185,000 in 2023. This shows a consistent upward trend. As an emerging industry, it faces challenges due to

incomplete regulations and a lack of past experience in accident prevention. Additionally, its business model based on per-order pricing tends to encourage speeding. Moreover, traffic violations by delivery riders have increased, with "failure to yield" being a leading cause of accidents for decades. According to Article 102, Paragraph 1 of the Road Traffic Safety Regulation and regulations in various countries, when conflicts occur, the right-of-way rules for each direction are defined. When there is a violation of the right-of-way, accidents are more likely to happen. Therefore, this study aims to clarify the yielding behavior of motorcycle delivery riders at non-signaled intersections to propose methods for accident prevention and provide reference for future law enforcement, education, and other related fields.

E. Method of Research & Progression

With the surge in delivery orders, the number of delivery riders has seen a steady increase, growing from 45,000 in 2019 to 87,000 in 2020, 102,000 in 2021, 155,000 in 2022, and reaching 185,000 in 2023, demonstrating a consistent upward trend. As an emerging industry, the delivery sector faces challenges stemming from incomplete regulations and limited experience in accident prevention. Its business model, which relies on per-order pricing, often incentivizes speeding, further contributing to safety concerns. Traffic violations by delivery riders have also risen, with "failure to yield" remaining a leading cause of accidents for decades. According to Article 102, Paragraph 1 of the Road Traffic Safety Regulations, as well as similar rules in other countries, right-of-way conflicts at intersections are clearly defined to reduce the likelihood of accidents. However, violations of these right-of-way rules significantly increase the risk of collisions. This study focuses on examining the yielding behavior of motorcycle delivery riders at non-signaled intersections to identify key factors influencing such behavior. The findings aim to propose effective accident prevention strategies and provide valuable insights for future law enforcement, public education campaigns, and related policy development.

F. Results of Research

This study observed a total of 36 hours across three intersections, covering various time periods, including holidays, peak hours, off-peak hours, and nighttime. A total of 3,581 data points were collected, with two records excluded due to missing information, resulting in 3,579 data points for analysis. Of these, 1,714 records (48%) indicated yielding behavior, while 1,864 records (52%) showed non-yielding behavior. Specifically, among the 1,453 data points related to delivery riders, 577 records (40%) demonstrated yielding behavior, whereas 875 records (60%) reflected non-yielding behavior.

1. The binary logistic regression analysis identified six significant variables influencing the likelihood of failing to yield to pedestrians: pedestrian traffic rule violations, the position of the unyielded pedestrian, the motorcycle's initial position, the number of pedestrians, whether the rider is a delivery person, and the number of delivery boxes. Motorcycle riders are more likely to yield when pedestrians violate traffic rules, possibly because pedestrians not using the crosswalk exhibit less predictable movements, such as sudden acceleration or changes in direction, making it harder for riders to anticipate their actions. Riders are less likely to yield to pedestrians who are still outside the roadway, likely due to two reasons: pedestrians in these positions are harder to notice, and riders are uncertain about their intent to cross. The likelihood of not yielding is highest among riders not waiting in a queue, aligning with the findings of Steven et al. (2017). Observational footage indicates that riders outside the queue tend to drive faster and more aggressively, making them less likely to yield. Conversely, the probability of yielding increases with the number of pedestrians, a result consistent with Ahmed Al-Kaisy's (2018) findings. A larger group of pedestrians tends to be more visible, and when the crosswalk becomes crowded, riders find it more challenging to navigate through and are compelled to yield.
2. The multinomial logistic regression analysis identified several significant variables influencing failure to yield: peak and off-peak times, the motorcycle's initial position in the queue, the yielding target, nighttime conditions, whether the rider is a delivery person, and the position of the delivery box. For failure to yield to vehicles traveling straight, the significant variables include peak and off-peak times, the motorcycle's initial position in the queue, the yielding target, nighttime conditions, whether the rider is a delivery person, and the position of the delivery box. In cases of failure to yield to vehicles approaching from the right, the influencing factors are peak and off-peak times, the motorcycle's initial position in the queue, the yielding target, and whether the rider is a delivery person. When analyzing failure to yield to left-turning vehicles by right-turning motorcycles, the sole significant factor is whether the rider is a delivery person. The likelihood of not yielding to vehicles traveling straight is higher when the yielding target is a car rather than another motorcycle. This is likely because cars generally slow down when passing through intersections, creating gaps that right-turning motorcycles exploit. Motorcycle riders are also more likely to fail to yield to vehicles on their right if those vehicles are motorcycles rather than cars. This behavior may be due to the limited field of vision for motorcycles and the increased difficulty of observing right-side roads when entering an intersection. Larger vehicles, such as cars, are more easily noticed in these scenarios.

3. It is evident that delivery riders are more prone to failure-to-yield behaviors compared to non-delivery motorcycle riders, particularly those managing dual deliveries. This aligns with the initial assumptions of this study and reflects current road conditions. Riders handling dual deliveries experience heightened time pressure, as they aim to minimize the interval between two deliveries and maximize the number of orders fulfilled within a given timeframe. This increased urgency makes them more likely to exhibit aggressive, non-yielding behaviors.

G. Future Areas to Take Note of, and Going Forward

1. The number of factors associated with delivery riders in this study is limited to four main variables. This limitation stems from the research method, which relied on video recordings, with factor selection primarily based on observable "visual characteristics." Future research could delve deeper into personal attributes of delivery riders, such as gender, age, daily working hours, and daily income, to provide a more comprehensive analysis.
2. Given the research design and selected response variables, the experimental site was limited to intersections with consistent characteristics: the same number of lanes, no traffic signals, and no stop or yield signs. However, such intersections are relatively rare. Future studies could explore whether intersections with varying conditions—while still requiring the same yielding behavior—produce similar results. Additionally, future research could investigate other yielding behaviors mandated by traffic safety rules, such as yielding from branch roads to main roads, and examine the factors influencing motorcycle riders' yielding behavior at intersections with clearly marked stop or yield signs.

H. Means of Official Announcement of Research Results

Proposed as a thesis of master's degree of Graduate program of Department of Transportation and Logistics Management, National Yang Ming Chiao Tung University.