האוניברסיטה העברית בירושלים

הפקולטה למדעי החברה

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נייר מדיניות בנושא:

בטיחות של רוכבי דו-גלגלי

המלצה לצמצם המעורבות של רוכבי דו-גלגלי בתאונות דרכים

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Policy Client

Minister Israel Katz, Ministry of Transport, National Infrastructures, and Road Safety.

The purpose of this policy paper is to identify the challenges with respect to fatal and serious motorcycle[1] accidents on Israel's roads, to identify potential measures to reduce these accidents, and to propose a solution to this problem.

The Ministry of Transport, National Infrastructures, and Road Safety is responsible for planning, developing, and regulating Israel's infrastructure and integrated transport systems, and promoting safety and mobile logistics services, to contribute to the nation's social and economic growth. Established in 1948 and with 1,029 employees, the Ministry's budget for 2011 was approximately NIS 16 billion.

Minister Katz has argued that the rate of vehicle accidents is one of his major issues, and that everyone must work towards reducing accident occurrence on Israel's roads (MOT, 2013). He has supported changes in the testing scheme for motorcycle licenses, and has focused on the safety of motorcyclists as vulnerable road users (MOT, 2012). He is the leader with the greatest influence on transportation policy, and is in the position to approve and advance changes in testing and education policy for motorcycle riders.

[1] For simplicity, the term **motorcycle** encompasses all powered two wheel vehicles, including scooters and mopeds.

Executive Summary

Motor vehicle accidents in Israel have been declining for the past decade, but this trend has not appeared among motorcyclists. The rate of motorcycle accidents, notably serious and fatal crashes, have increased over the past five years. Moreover, young riders and new motorcycle license holders are at risk of disproportionately high rates of motorcycle accidents. These accidents have high social and economic costs, and therefore should be minimized. Police statistics, survey data, and international studies indicate that the level of risk awareness of motorcyclists is correlated with crash rates, and that young and inexperienced riders generally have less-developed senses of risk than those with more years and kilometers of riding. The lack of risk awareness skills among young and inexperienced motorcycle riders in Israel is a factor in the increasing accident motorcycle rates and the high rate of accidents in these populations in particular.

Three options are presented to reduce the rate of motorcycle accidents among young and inexperienced riders. First is the introduction of a pilot program involving training on a motorcycle simulator to safely expose new riders to dangerous road conditions. Second is the implementation of a Hazard Perception Test in the licensing system. Third is creation of a formal risk perception training program involving analysis of individual rider's videotaped riding habits.

Based on various evaluation criteria, the introduction of a Hazard Perception Test is recommended as an efficient and cost-effective method to reduce the rate and number of serious and fatal motorcycle accidents on Israel's road, particularly among young and new riders.

Table of Contents

Introduction

Over the past five years, traffic accidents on Israel's roads have decreased by over 30%, while the number of vehicles on the roads have steadily increased (Sofer, 2012). Even among fatal and serious accidents[2], the trend has been positive – driving in Israel is safer than ever.

Motorcycles have not followed this safety trend. As a percentage of Israel's registered vehicles, motorcycles have represented about 4% of all vehicles on the road for the past three decades (CBS, 2012a). Additionally, 88% of all motorcycles in Israel have an engine capacity of 125cc or below, which roughly corresponds to the maximum power output allowed for an A2 motorcycle license holder.[3] Motorized two-wheeled vehicles remain popular in Israel due to their competitive pricing compared to cars, fuel efficiency, contribution to lower traffic congestion, and rider enjoyment (Zeidel and Zilberstein, 2011).

Motorcyclists, however, are considered vulnerable road users due to common characteristics. First, motorcycles are stable only when moving; when stopped or when skidding, such as when brakes are applied incorrectly, the rider is likely to lose control and may crash (AEMM, 2004). Additionally, motorcycles lack the structural safety of passenger vehicles so in the event of a collision or loss of control, there are almost no safety features on motorcycles to protect the rider from injury. [4] Lastly, motorcycles are significantly smaller than passenger cars and are therefore often difficult for other vehicle riders to see in traffic. The combination of inherent instability and exposure to traffic and injury mean that when a motorcycle accident does occur, the chances of an accident being either serious or fatal are much higher than in any other type of motorized vehicle.

The Disproportionate Rates of Motorcycle Accidents

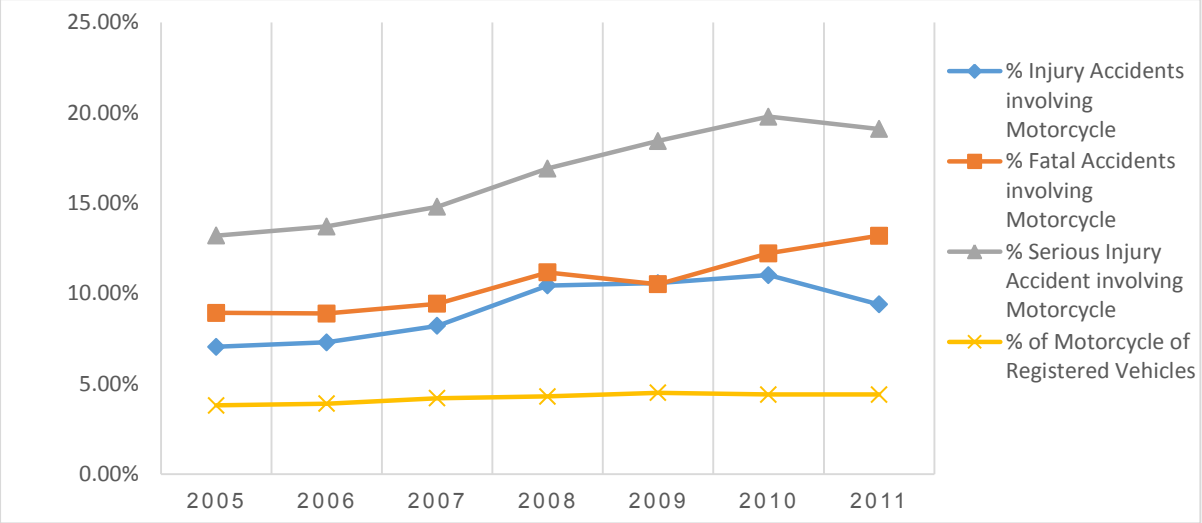
Despite the national downward trend, however, traffic accidents involving motorcycles have ***increased*** since 2005. Even more striking is the increase in fatal and serious motorcycle accidents, which indicate an even more troubling upward trend, as shown in Figure 1:

[2] A serious accident is one in which a driver or passenger is hospitalized for over 24 hours.

[3] Refer to Annex 1 for a description of current licensing regulations.

[4] Airbag safety systems are available on a handful of expensive touring-style motorcycles, such as the Honda Goldwing.

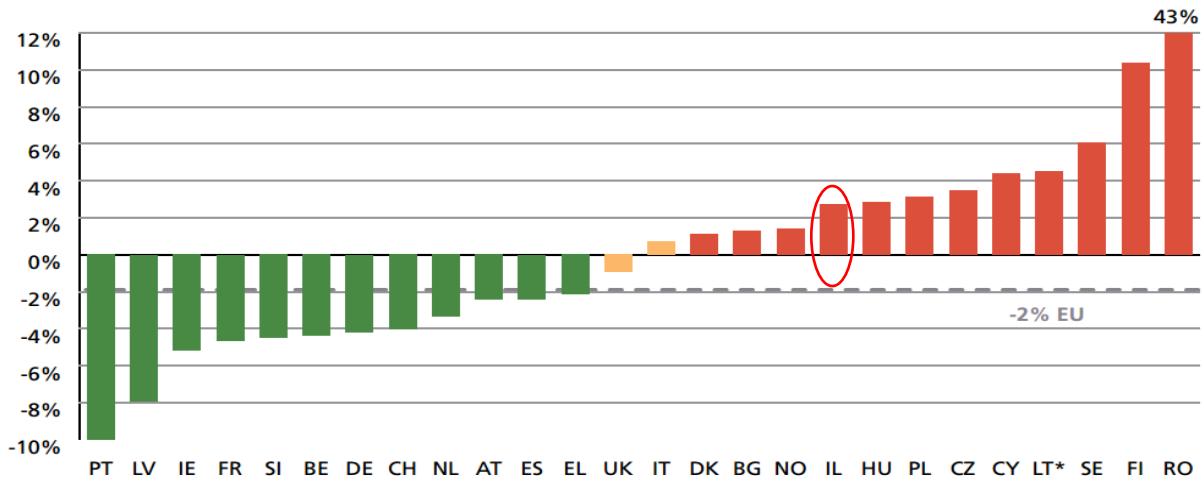
Figure 1: Percentage of Accidents Involving a Motorcycle, By Severity of Accident, 2005-2011



Source: Israel National Road Safety Authority, Trends of Road Safety in Israel, 2005-2011 (2012).

Additionally, in 2011 motorcycles were two and a half times as likely to be in an accident compared to their portion of the vehicle population, and more than four times as likely to be in an accident compared to their portion of annual kilometers travelled (CBS, 2012b). As Figure 2 shows, Israel is behind the European Union's trend, which on average has reduced its fatal motorcycle accidents by 2% over the past decade (Jost, et al., 2011):

Figure 2: Average Annual Percentage Change in Motorcycle Rider Deaths, 2001-2009



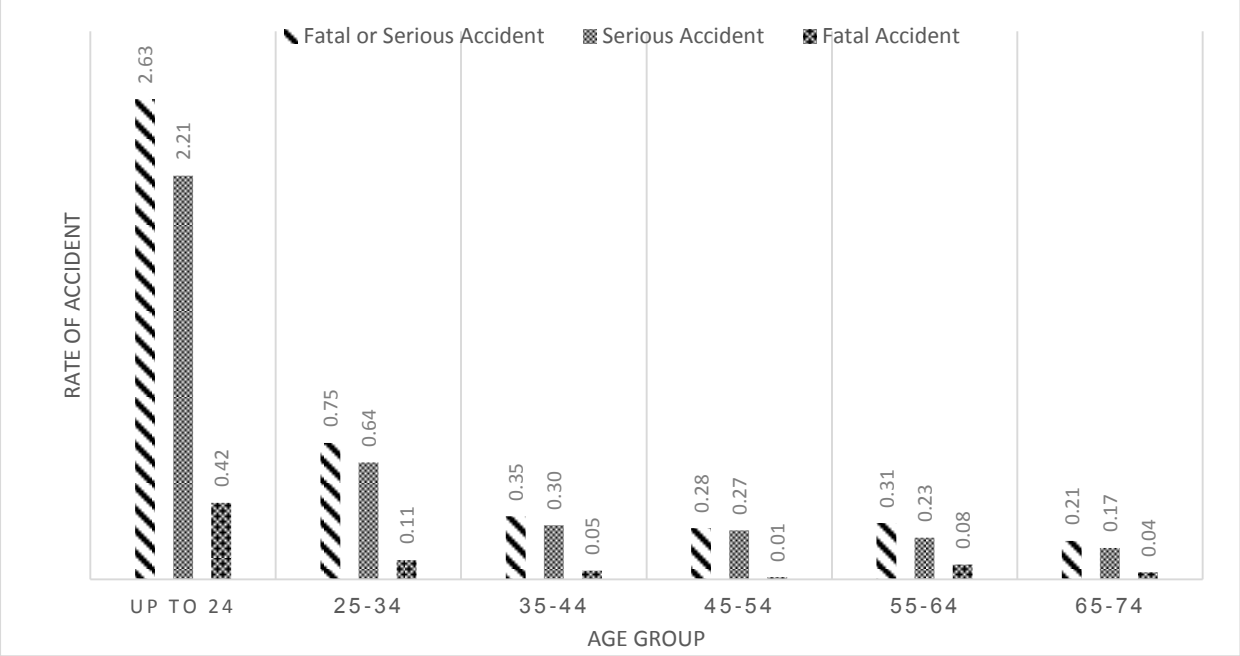
Source: 5th Road Safety PIN Report, 2010. ETSC (2011).

Vulnerability of Young and Inexperienced Motorcycle Riders

When looking closely at accident data, it is apparent that both young and inexperienced vehicle operators are at the greatest risk for serious and fatal accidents. Numerous studies show that both age and experience are linked to accident risk, although attempts to disaggregate the two variables have led to inconclusive results (Harrison and Christie, 2005; Rutter and Quine, 1996).

In terms of youth, the statistics in Israel show that young motorcycle riders are significantly more likely to be in a serious or fatal accident than older riders. Per 1,000 riders, motorcyclists under the age of 25 are more than three and a half times as likely to be in serious accidents as riders aged 25-34, and more than four times as likely in terms of fatal accidents. As shown in Figure 3, young riders are particularly vulnerable on the road:

Figure 3: Involvement of Motorcycle Riders in Serious and Fatal Traffic Accidents per 1,000 riders, 2011

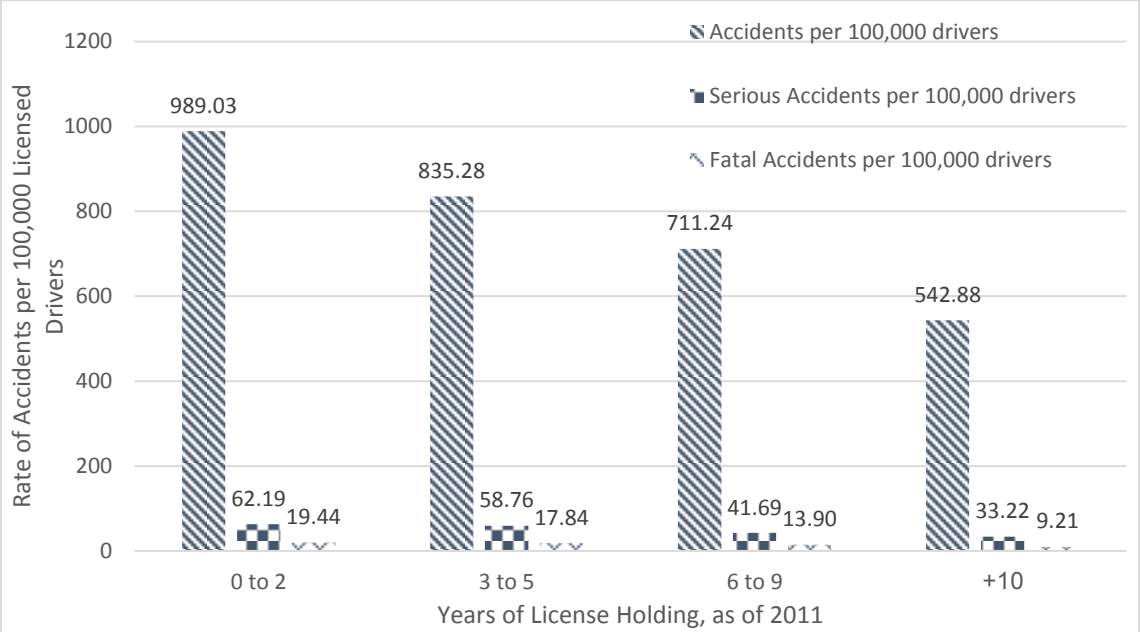


Sources: Central Bureau of Statistics (2012), Statistical Abstract of Israel 2012 – No. 63, Subject 24, Table 25. Licensed to Drive by Year License Issued and Age; Central Bureau of Statistics (2012), Road Accidents with Casualties 2011, Part 1: General Summaries, Publication No. 1492, Chapter 4, Table 1, Drivers Involved in Road Accidents, by Severity, Type of Accident, Age, and Sex.

While data regarding traffic accidents and years of license holding do not differentiate between car and motorcycle license holders, the general trend indicates that the risk of a traffic accident decreases the longer an individual holds a license for any type of vehicle.

Figure 4 shows a 16% decrease in accident involvement, a 5.5% decrease in serious accident involvement, and an 8% decrease in fatal accident involvement after holding a license for more than 2 years. Internationally, studies indicate that riders are most vulnerable to accidents during the first 18 months of holding a motorcycle license (European Commission, 2011). Simply put, Israel's young and inexperienced riders remain at a significantly high risk for involvement in a serious or fatal traffic accident.

Figure 4: Rate of Accidents, per 100,000 Licensed Drivers, By Years of Holding License, 2011



Sources: Central Bureau of Statistics, Statistical Abstract of Israel 2012 – No. 63, Subject 24, Table 25. Licensed to Drive by year license issued and age; Central Bureau of Statistics (2012), Road Accidents with Casualties 2011, Part 1: General Summaries, Publication No. 1492, Chapter 4, Table 2, Drivers Involved in Road Accidents, by Severity, Type of Accident and Years of License Holding.

Motorcycle Riders Can Avoid Accidents

Survey and police data also indicate that in many cases, motorcycle accidents were avoidable. In a survey conducted by the Israel National Road Safety Authority (RSA) in 2011, 84% of responding riders remarked that an accident in which they had been involved was completely their fault, or their fault as a result of the actions of another vehicle (Zeidel and Zilberstein, 2011). Police data from 2011 shows that nearly half of all motorcycle accidents occur without damage or injury to another vehicle, indicating that the rider lost control of his motorcycle due to a lack of skill, road conditions, or in avoiding the actions of another vehicle (CBS, 2012c). Among riders themselves, 25% admit that they could have

avoided their accident and another 37% believe that they *should* have avoided their accident but reacted too late or incorrectly to avoid the incident (Zeidel and Zilberstein, 2011). With most riders tending to overestimate their capabilities (Zeidel and Zilberstein, 2011; Horswill et al., 2004), it is likely that the actual amount of avoidable accidents is higher than these self-reported numbers. However, when analyzing fault in traffic accidents involving motorcycles, the significant number of accidents caused by the actions of drivers of other vehicles should not be discounted. In the estimation of the RSA, nearly 40% of traffic accidents involving motorcyclists are caused by other vehicles (Zagman, 2013a). Indeed, the inattention of drivers, their inability to identify motorcyclists, and misunderstanding of the capabilities and vulnerabilities of motorcyclists are significant challenges to motorcycle safety. As vulnerable road users, however, motorcyclists must manage their personal risk.

Economic Costs of Motorcycle Accidents

The costs of motorcycle accidents extend beyond the damage to the motorcycle itself, damage to other vehicles, and the costs associated with investigating and documenting the accidents by the police. The social costs of motorcycle accidents, in particular the emotional suffering of families and friends, are difficult to enumerate. However, in an analysis of NRSA data by the safety organization Or Yarok (2012), the cost of a traffic fatality in Israel is estimated to be ₪ 5.58 million, whereas a serious motorcycle injury costs ₪ 1.1 million. Table 1 shows the costs of these accidents from 2005 to 2011, highlighting the social cost of this trend.

Table 1: Economic Costs of Motorcycle Fatalities and Serious Accidents, 2005-2011

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**7-Year Total**
Motorcycle Fatality (million ₪)	217.6	200.9	200.9	256.7	184.1	239.9	251.1	1551.24
Motorcycle Serious Accident (million ₪)	343.2	347.6	341	383.9	353.1	366.3	281.6	2416.7
Total Economic Cost (million ₪)	560.8	548.5	541.9	640.6	537.2	606.2	532.7	3967.94

Sources: Israel National Road Safety Authority, Trends of Road Safety in Israel, 2005-2011 (2012); Or Yarok (2012).

Current Policies to Reduce Motorcycle Accidents

In accordance with some of the Reducing the number and rate of motorcycle accidents, therefore, is of international concern, not least of which within Israel. Several studies have been conducted or are in progress to better understand the reasons and causes of motorcycle accidents in order to reduce fatalities and injuries, and many policies are already in use in Israel.

Protective Equipment and Visability

Israel maintains a near 100% helmet wearing rate among motorcyclists; it is extremely rare to find a rider without a helmet (Zagman, 2013b). The wear of additional protective clothing beyond a helmet remains low in Israel (Zeidel and Zilberstein, 2011), particularly among scooter riders, which may be a contributing factor to the rate of serious accidents (de Rome et al., 2012).[5] Additionally, all motorcycles are required to have their headlights illuminated both day and night (Zagman, 2013b).

Pre-License Training

Riding a motorcycle is a complex physical and cognitive task - more so than driving a car - due to the inherent instability and vulnerability of a motorcycle. Important skills are not only the motor skills for the safe operation of the motorcycle (Mannering and Grodsky, 1995; Houston, 2011), but also proper control of the motorcycle in emergency situations, particularly swerving and proper application of brakes without losing control (Teoh, 2011). The Road Safety Authority is updating the skills test for motorcyclists, which will require the student to perform more realistic maneuvers, with the expectation that this will make riders safer on the road. International studies indicate that skills training alone has negligible impact on the reduction of accidents, and may actually increase accident risk (Elvik et al., 2009). One suggestion for this phenomenon is that as riders increase their skills, they simultaneously reduce their risk perception and expose themselves to more dangerous situations (Beanland et al., 2013).

[5] There is limited protective clothing suitable to hot climates and the effects of heat stress on accidents may obviate any safety gained by mandating their use in Israel. See de Rome et al., 2012, for more details.

Accident Factors: Vehicle, Environment, Human

The 2004 Motorcycle Accidents In-Depth Study[6] (MAIDS) modeled accidents based on vehicle factors, environmental factors, and human factors.[7] In the MAIDS study, human factors accounted for 43.7% of all accidents involving motorcycles, with decision failures and perception failures by motorcycle riders accounting for 25% of all accidents (AEMM, 2004). Failures in attention, traffic strategy, or high speed compared to surrounding traffic are examples of these failures that were the primary cause of these accidents.

Challenges to Limiting Accident Factors

Based on the 2012 survey of motorcycle riders in Israel, vehicle and environmental factors are less prevalent as causes of motorcycle accidents in Israel (Zeidel and Zilberstein, 2011). Additionally, improvements to vehicle and environmental factors are expensive or difficult to implement. One motorcycle improvement shown to significantly reduce fatal traffic accidents is an anti-lock braking system (ABS) (Teoh, 2011), which will be required on all new motorcycles over 125cc in Europe in 2016. Since it imports its motorcycles from the EU, Israel will follow suit. However, since 88% of motorcycles in Israel are 125cc or under, the safety effect may be limited.[8] Other safety features such as an air-bag system are only available on expensive touring model motorcycles, and Advanced Rider Assistance Systems that warn riders of potentially dangerous traffic situations are still under development.

Environmental solutions to motorcycle accidents such as high-friction road paint and lower guardrails do not match the pattern of traffic accidents in Israel, where the majority accidents occur in urban areas and most motorcyclists do not ride in the rain (CBS, 2012a; Zeidel and Zilberstein, 2011). Additionally, dedicated motorcycle lanes and stopping areas at traffic lights are expensive to implement, particularly when motorcycles remain just 4% of vehicles on the road. While vehicle and environmental factors are important, they are not the most efficient areas in which to invest accident reduction efforts.

[6] In 2004 the European Association of Motorcycle Manufacturers and the European Commission released its first analysis of the MAIDS data, analyzing 921 accidents over 3 years in 5 countries.

[7] Vehicle factors for accidents include motor and structural failures of a motorcycle or car, while environmental factors include road infrastructure and weather such as rain or snow. Human factors for accidents involve failures of perception, comprehension, decision, or reaction by either a rider or driver.

[8] It should be noted here that the most motorcyclists riding a 125cc motorcycle or below only carry compulsory insurance, which is set by law (Zagman, 2013a).

Risk Awareness as a Key Human Factor in Accidents

The human factor is the area which is most suitable for effective, targeted policy for reducing motorcycle accidents. Policy should be implemented to address the most risk-prone population - young and inexperienced riders. The perception and comprehension of road hazards these riders, which includes their own perception of risk relative to traffic, physical road conditions, and the actions of other vehicle drivers, remain underdeveloped by the time they receive their license and may be the most important factor in traffic accidents (Horswill and McKenna, 2004). This can be defined as immature *risk awareness:* the combination of *hazard detection*, a rider's skill in perceiving critical events and identifying them as threats, and *situational criticality assessment*, a rider's assessment of the situation and its dangerousness in relation to his or her capabilities (Bellet and Banet, 2012). Numerous studies indicate that the higher rate of road accidents among inexperienced drivers is at least partly explained by their slower reaction time to hazards compared to experienced drivers (Groeger and Chapman, 1996, McKenna and Crick, 1994, Quimby et al., 1986) – moreover, hazard perception can be trained (Wallis and Horswill, 2007). Therefore, the problem is clear: motorcycle riders are effectively untrained in risk awareness, leading to high rates and risks of fatal and serious traffic accidents particularly among young and inexperienced riders.

Proposed Policy Solutions

In order to reduce the risk of serious and fatal motorcycle accidents, training and evaluation of a rider's hazard perception and situation assessment skills should occur before an unrestricted motorcycle license is issued to a rider. This will ensure that both young and novice motorcyclists are best prepared for safe riding when they receive their license, which coincides with the period that they are at the highest risk of accident involvement. Three policy options are presented below, each of which have the potential to reduce the number of injured and killed motorcyclists on Israel's roads. While this paper does not specifically address funding options, each proposal could be partially funded by an additional 5 ₪ increase in the annual motorcycle registration fee.

Proposal 1: Mandatory Simulator Training

In a motorcycle simulator, riders are presented with complex traffic and road conditions and must respond to them by manipulating controls on a mock motorcycle. In a simulated environment, riders can face dangerous conditions and hazards that cannot be safely presented on the road such as pedestrians, vehicles performing illegal or dangerous

maneuvers, and weather changes. Riders can therefore improve their hazard perception skills as well as demonstrate their emergency maneuver skills in the event of an unexpected hazard.

Aviation and medical evaluations of simulators have shown that skills effectively transfer to real-world performance (Goode et al., 2013). Among driving simulators, studies have indicated that simulation-based hazard perception training increases visual scanning ability and focus on potential hazard areas during on-road evaluations (Pradahn et al., 2009). However, there is no consensus on the tie between simulator training and crash risk (Goode et al., 2013), while others have indicated that training in a high-fidelity simulator reduces crash risk better than low-fidelity simulators (Falkmer and Gregersen, 2003; Allen et al., 2007, 2010). Japan has required 3 hours of simulator training for all motorcycle learners since 1996, but the effects of the regulation's implementation on accidents is unclear (Awane, 1999). Experts believe that a motorcycle safety simulator would be a promising development (Shinar, 2013).

The implementation of simulator training as an additional component to the motorcycle licensing requirements may significantly improve the hazard perception and critical situation assessment capabilities of new and young riders. Performance would be evaluated by an instructor, but the simulation would be an additional requirement, not an additional test.

Proposal 2: Hazard Perception Test

A Hazard Perception Test (HPT) is a computer-based exam during which students must identify emerging hazards during a series of on-screen video clips and click a button when they perceive a hazard or potential hazard. Students are scored based on reaction time to the hazard, and must reach a certain threshold to pass the exam. Variations of this type of exam are in use in the United Kingdom and Australia, and are requirements for either receiving a permit or advancing from a permit to a full driving license. Studies indicate that scores on a HPT predict crash risk during the first year of holding a license (Boufous et al., 2011). In a British study, learners who passed the Hazard Perception Test had at least a 3% reduction in their crash liability, while those who scored the highest category on the test had at least a 4.5% reduction (Wells et al., 2008). Those who score higher on the HPT perceive hazards more like experienced riders (Hosking, et al., 2010), indicating that they will have lower individual crash risks compared to their peers.

An HPT will cause young novice riders to train themselves or otherwise seek training to build motorcycle-specific road hazard identification skills, since they must pass the exam in order to receive their license. When preparing students for the HPT, instructors may discuss safety theory with students which may improve overall hazard perception capabilities (Meir et al., 2010). It will also prohibit those without basic hazard perception skills from actually receiving a license, keeping those without the skills off of the road.

An HPT requires a set of video clips that show motorcycle-specific hazard situations and a creation of a computer program to run and score the examination. The computers used for the mandatory theory test may be used for the HPT. The test itself would occur immediately before the practical skills test for receiving the motorcycle license, and would last approximately one hour including instructions and practice.

Proposal 3: Formal Training of Higher Cognitive Skills

Riders will participate in a day-long hazard perception and avoidance course, which includes theoretical training and a ride in traffic with other students while the instructor videotapes. After each student is videotaped, the group returns and reviews the taped riding. The instructor and students evaluate the rider's perception of road hazards and techniques the rider used or did not use to reduce accident risk when presented with these hazards.

This method is currently used by the Royal Dutch Motorcyclists Association. Approximately 6 months after receiving hazard perception training and videotaped evaluation of on-road riding, riders who received the training improved both their score on a HPT as well as improved their safe riding ability as evaluated by instructors compared to a control group. Importantly, these riders did not believe they were safer riders, which indicates that the problem of cognitive bias was avoided. The long-term impact on accident statistics for trained students is currently being studied (Boele et al., 2013). In addition to an improvement in hazard perception skills this type of group evaluation may also improve riders' attitudes towards risk taking, an area that is also correlated with accidents among young and novice riders (Watson et al., 2007).

Implementation of this technique will require a change in the licensing structure. Upon completion of the currently required training and practical tests, riders will be issued a provisional license which would prohibit them from riding with passengers or at night. Similar to the mandatory driving theory course that all new drivers must take within 5 years, the curriculum would be established by the Ministry of Transportation and training contracted

to instructional organizations. Students would be required to take the formal training course and evaluation within 6 months to receive their unrestricted license; if the course is not taken within this time, the license is revoked. This course would exempt riders from the general mandatory theory training that is required within 5 years of receiving any license.

Criteria for Evaluation

Evaluation criteria for the three proposals are presented on a scale from 1-5, with 5 being the best score. Criteria include:

- Reported extent of accident reduction (30%): This criteria is based on the *actual* reduction in motorcycle accidents, as reported in academic studies.
- Expected extent of accident reduction (30%): This criteria is based on the subjective *potential* of future or developing techniques for reducing motorcycle accidents.
- Cost (20%): Implementation and sustainment costs of the policy over a 5 year period.
- Political and social feasibility (10%): Ability to implement the proposal, including interest group and public support.
- Time to full implementation (5%): Amount of time needed to fully implement the proposal.
- Safety and comfort (5%): Safety of both the student and the evaluator, comfort of the student.

Comparison among Policy Solutions

Reported Extent of Accident Reduction:

1. Simulator: Motorcycle training simulators are only in use in Japan, and academic reports concerning their effectiveness are sparse or incomplete. Rating: 2
2. HPT: Hazard Perceptions Tests are in use in a number of countries, and have shown effectiveness in reducing the accident rate, although at levels around 3-5%. Rating: 3.
3. Formal Training with Video: One study was conducted in the Netherlands, and the long-term impact of the training on accident rates is under investigation. Rating: 1.

Potential Extent of Accident Reduction:

1. Simulator: Use of flight simulators in military and commercial applications have shown a sharp reduction in accident rates, over 50%. This is due to over one hundred

hours of training, however. Motorcycle simulators could have positive effects, but for comparison considerations a potential of 6% reduction is used. Rating: 5.

2. HPT: Expected reductions in accident rates are around 3-5%. For comparison considerations, a potential of 4% is used. Rating: 2.
3. Formal Training with Video: This training and evaluation includes detailed instructor feedback and addresses social dimensions, which may also influence risk behavior. A potential of 5% reduction in accidents is used. Rating: 4.

Cost (See Appendix 2 for Cost Analysis):

1. Simulator: Net savings of 58,469,350₪, but with a high initial cost. Rating: 1.
2. HPT: Net savings of 78,299,350₪. Rating: 4.
3. Formal Training with Video: Net savings of 125,915,100 ₪. Rating: 5.

Political and Social Feasibility:

1. Simulator: With no impact on the training programs of private driving instructors, the political opposition to simulators would be limited. Citizens may oppose additional training requirements. Rating: 4.
2. HPT: Private driving instructors would be required to change their curriculums to ensure their students pass the HPT and may oppose the measure. Rating: 3.
3. Formal Training with Video: The addition of an additional day of training and its associated costs may see citizen opposition. Rating: 2.

Time to Full Implementation:

1. Simulator: Since this option includes a pilot program, full implementation in the case of a successful pilot would take the longest of all of the solutions. Rating: 1.
2. HPT: The creation and distribution of an HPT could be accomplished in as little as two years. Rating: 4.
3. Formal Training with Video: A formal curriculum could take over a year to produce, possibly an additional year to approve and refine, and an additional year of selecting and educating instructors. Rating: 3.

Safety and Comfort:

1. Simulator: A simulator is safe, but video and motion may cause nausea among some students. Rating: 3.

2. HPT: An HPT is both safe and includes no motion-sickness side effects. Rating: 5.
3. Formal Training with Video: Students and instructors are exposed to road hazards. Rating: 2.

Summary and Recommendation

Table 2, below, combines the weighted criteria with the evaluation of each policy option to arrive at an aggregate score indicating the most preferred policy.

Table 2: Comparison of Policy Options

Cost	Weight	Simulator	HPT	Formal Training with video
Reported extent of accident reduction	30%	2 (0.6)	3 (0.9)	1 (0.3)
Potential extent of accident reduction	30%	5 (1.5)	2 (0.6)	4 (1.2)
Cost	20%	1 (0.2)	4 (0.8)	5 (1)
Political and social feasibility	10%	4 (0.4)	3 (0.3)	2 (0.2)
Time to full implementation	5%	1 (0.05)	4 (0.2)	3 (0.15)
Safety and comfort	5%	3 (0.15)	5 (0.25)	2 (0.1)
Total	100%	2.9	3.05	2.95

With a total evaluated score of 3.05, the recommended policy is the establishment of a Hazard Perception Test. A Hazard Perception Test is an established method for reducing traffic accidents, and will help reduce serious and fatal accidents, particularly among young and inexperienced riders. Conservative estimates of a 3% reduction in accidents would reduce the social costs of these crashes by almost NIS 20 million per year; over a 5-year period this is an ultimate savings of 96,500,000 ₪. Creating an HPT is also cost effective, requiring minimal administrative or personnel cost once it is established. It is unlikely to meet political conflict, and can be fully implemented relatively quickly. It also does not endanger the student or the instructor, nor is it likely to induce nausea in the student. Therefore, an HPT is the surest way to reduce motorcycle accidents in Israel, particularly among young and inexperienced riders.

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Appendix 1: Outline of Current Driver Licensing Scheme

Type of License	Power Output	Minimal Age, Theory	Minimal Age, Lessons	Minimal Age, Practical Test	Minimum number of Lessons	Exemptions
A2	<11kW (~125cc)	15.5	16	16	15	Class B license holder for 3 years, no theory test no lessons
A1	<33 HP, 25KW (~400cc)	17.5	18	18	15 (8 for A2 license holder)	
A	>33HP, 25 KW (400cc+)	18	18	21	8	
B	Car	16.5	16.5	17	28	

Appendix 2: Cost Analysis

1. Simulator

   One-time Cost

   - Simulator Cost
     Since high-resolution and moving simulators are correlated with greater skills transfer than static and low-resolution products, cost is computed according to the cost of the more expensive of the commercially available systems, which is 235,000₪. Assuming the purchase of 100 systems, total fixed cost is 23,500,000₪.

   Ongoing Fixed Costs

   - Administration (instructor, processing results)
     Fixed ongoing costs for administration over the course of a year for an instructor is 110 instructors at a monthly salary of 7,000 ₪is 9,240,000₪. Administrative support involving 66 employees, assuming two administrators at each training site, with a monthly salary of 5,700₪ is 4,514,400₪.

   - Simulator space
     There may be room at certain testing centers to house simulators. However, assuming needing 10 m^2 for each simulator and therefore 1000 m^2 total and assuming a 75₪ per m^2, the annual leasing fee would be 900,000₪.

   Varying Costs

   - Simulator maintenance and wear, including electricity and water.
     Annual costs for maintenance would be approximately 8,000 ₪per simulator, for a total annual cost of 800,000₪. Facility maintenance and utilities estimate is 700,000₪.

   Recoupable Costs and Savings

   - With 117,254 registered motorcycles in 2011, a "Motorcycle Safety Fee" of 5 ₪for each registered motorcycle would garner 586,270₪ per year.
   - Assuming a 6% annual reduction in both fatal and serious motorcycle accidents as a result of the program, social savings would be 31,962,000 ₪per year.

   Total 5 year Cost:

   - Total costs: 104,272,000₪
   - Total savings: 162,741,350₪
   - Net savings: 58,469,350₪

2. Hazard Perception Test
   One-time Cost
   - Video capture and programming
     Creating a hazard perception test requires gathering video footage of realistic and dangerous road situations and the creation of a testing and evaluation program. The cost for a similar proposed program development in the EU was 3,500,000₪ (Initial Rider Training, 2007).

   Fixed Ongoing Costs
   - Administration (processing results)
     Assuming two additional administrators at each testing side, administrative support would involve 66 employees with a monthly salary of 5,700₪ for an annual sum of 4,514,400₪.

   Varying Costs
   - Assuming a team of five programmers to maintain the system, at 17,000 ₪per month salary program maintenance and troubleshooting would cost 1,020,000 ₪per year.

   Recoupable Costs and Savings
   - With 117,254 registered motorcycles in 2011, a "Motorcycle Safety Fee" of 5 ₪for each registered motorcycle would garner 586,270 ₪per year.
   - Assuming a 4% annual reduction in both fatal and serious motorcycle accidents as a result of the program, social savings would be 21,308,000 ₪per year.

   Total 5 year Cost:

   - Total costs: 31,172,000₪
   - Total savings: 109,471,350₪
   - Net Savings: 78,299,350₪

3. Formal Training with Video
   One-time Cost
   - Curriculum development and production
     Developing a training curriculum and its associated training products could cost approximately 210,000₪.
   - Training of initial block of instructors, assuming 100 instructors and a cost of 9,000 ₪per instructor, with a total cost of 900,000₪.

   Fixed Ongoing Costs
   - Administration (processing results)
     Fixed ongoing costs for administration over the course of a year for processing course attendance is five administrators at a monthly salary of 7,000₪ is 420,000₪. 100 instructors earning 12,500 ₪per month leads to an annual cost of 1,250,000₪.

- Classroom space
  There may be room at certain testing centers for classroom discussions and video presentations. However, assuming needing 30 m^2 for a classroom at each testing site and assuming 75₪ per m^2, the annual leasing fee would be 74,250₪ .

Varying Costs

- Assuming instructor turnover of 10 per year, training new instructors at a cost of 9,000₪ per instructor, with an annual cost of 90,000₪.

Recoupable Costs and Savings

- With 117,254 registered motorcycles in 2011, a "Motorcycle Safety Fee" of 5 ₪for each registered motorcycle would garner 586,270₪ per year.
- Assuming a 5% annual reduction in both fatal and serious motorcycle accidents as a result of the program, social savings would be 26,635,000 ₪per year.

Total 5 year Cost:

- Total costs: 10,191,250₪
- Total savings: 109,471,350₪
- Net Savings: 125,915,100₪