Characterizing Risky Driving Behaviors of Electric Two-Wheelers Riders To Create Prevention Guidelines in China and in France

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Abstract

Today, Chinese people rely heavily on Electric Two-Wheelers (E2W), both the scooter and the bike styles (Cherry and Cervero, 2007), thus the production keeps growing (Asian Development Bank, 2009). This phenomenon coincides with a high rate of E2W rider mortality. However, reviewing the literature indicates a dearth of publications related to the characterization of E2W driver behaviors. In Europe, and more specifically in France, the prevelence of E2Wstarts to rise. In this regard, our ongoing collaborative research project, for which we introduce the framework in this paper, aims to develop new specific knowledge about the risk of E2W that would jointly serve immediate prevention needs in China and prospective prevention in France. In this paper, we first introduce the E2W's current place within road traffic and their benefits in France and China as well as the projected future growth of these vehicles. Secondly, we refer to the literature dedicated to Powered Two-Wheelers (PTW) to infer some common characterization with E2W. We continue with a description of the particular characteristic of road traffic in China. Then, we review the literature aiming to find out what defines dangerous/risky driving behaviors and how they are measured in the Chinese road context. Notably, we critically report the currently implemented tools that gauge either violation or dangerous, aberrant driving behaviors of both cars and two-wheelers. We point out a general lack of definition regarding the labels of "violation" and "risky driving behaviors." We argue the need to go beyond a classical but restrictive design in terms of errors, violations, or self/hetero aggressive intent. Finally, we suggest only operationalizing the defintion of risky driving behaviors provided by Dula and Geller (2003) in relation to E2W and PTW riders.

Keywords: driving behaviors, risk, electric two-wheelers riders, powered two-wheelers riders, China, France, social-cognitive psychologist approach

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The recent launch of research project seeks to meet concerns shared between France (IFSTTAR, Salon de Provence) and China (Tongji University, Shanghai) regarding Electric-Two-Wheelers vehicles (E2W or electric bikes), their vulnerability, and the risk that they entail. The broad goal of this ongoing collaborative research project is to contribute to a characterization of Electric-Two-Wheelers risky driving behaviors by adopting a social-cognitive psychological approach in respect of urban traffic planification considerations. Research studies in this project are all planned to be implemented among Chinese drivers in the Municipality of Shanghai. In this paper, we present the related relevant information which constitutes the framework and basis of knowledge of this project.

We first introduce the current position of this type of vehicle within the road traffic of France, and more broadly in Europe, in comparison to China. Additionally, their future perspective of growth is also introduced. The discrepancy of these figures illustrates that such an international research project will jointly serve prevention guideline immediate needs for the Chinese partner, and prospective prevention issues for the French counterpart by filling a dearth of knowledge in this field. Indeed, if the French road context seems favorable to the emergence of E2W, this type of vehicle is already very common in major Chinese cities. Thus, although China and France share some similar concerns and challenges for road safety regarding the E2W; the difference is that China is already confronted head-on by these problems. In this collaborative research, China (Shanghai) operates from France as a relevant observational field where risk driving conditions are in comparison to a climax.. Therefore this international collaboration experience will render the observation of some invariant

behaviors and identification of explanatory factors, that can't yet be observed or anticipated in France (beyond inter-cultural variations).

In a second part, we refer to general statements learned from literature dedicated to Powered Two-Wheelers (PTW) to construct a basis to characterize E2W driving behaviors and Chinese specificities regarding traffic road context and vehicles' interactions.

Subsequently, we investigate the literature in order to inform which definition and which operationalization are made of risky driving behaviors for two-wheelers to measure them. Such explorations lead us to critically examine currently utilized tools in China that gauge dangerous driving behaviors of both cars and two-wheelers's: The Chinese Driving Questionnaire (CDQ, Xie & Parker, 2002), the Aberrant Driving Behaviors Questionnaire (Shi, Bai, Ying & Atchley (2010), and The Chinese Motorcycle Rider Driving Violation (CMRDV, Cheng & Ng, 2010).

The rise of Electric-Two-Wheelers Vehicles

Electric-Two-Wheelers driving behavior remains to be characterized. Despite the many associated deaths and injuries that have been reported in countries where these vehicles operate, very few studies, either with direct observational or self-reported methodologies, have been conducted that might benefit efforts seeking to improve safety practices among E2W riders. Yet, Europe constitutes a context of increasing E2W use. A Pike Research report[i] estimates that their sales will double each year until 2017 in Western Europe, while France and Italy will experience an increase of over 120%. As everywhere else in countries where this mode of transportation grows, it has been found to be an interesting alternative to other modes for urban travel for both individuals and municipal governments.

With this in mind, French manufacturers had understood the issues at stake and have developed new, more efficient models including some equivalents to 125cc class like

Electric'city, Peugeot, MBK, Emax, Kios, Matram, SEV, Sweet'elec, XOR Motors[ii]. Indeed, such vehicles meet the challenges for mobility presented by urban dynamics. Free from constraints of public transportation (connections, waiting time, lack of comfort, incivility) and disadvantages of private cars (parking, traffic, cost), these vehicles possess the ability to traverse relatively long distances at faster rates within urban sprawls that are increasingly saturated with traffic. They also respond to environmental considerations (fight against air and noise pollutions) and economic ones (car maintenance cost, hyper-dependence to fuel carburant).

Hence, electric two-wheelers are multiplying in France as well as in other European countries as their performance improves. New battery technologies have brought them up to 100 km, which for the daily journey is usually sufficient (Riou & Verrier, 2009). Moreover, they are also a very economical vehicle to use (0.30 € per 100 km against 2-3 € / 2 liters per 100km, for an internal combustion engine model) and are low-maintenance (no mechanical, long life batteries). While, the purchase cost is still a barrier to their deployment, some incentives are implemented locally. For example, the municipality of Paris currently offers a subsidy designed to help with the purchase of any E2W.

Similarly in China, Electric Two-Wheelers have emerged during recent years as a popular mode of transportation and are already widespread in many large cities (Weinert and al., 2007). In fact, they compose the main part of the two-wheeled traffic beside regular bicycles. They are of two different varities: the scooter and the bike styles (Cherry & Cervero, 2007). In China, like many developing countries, clear and updated statistics are not always available regarding the distribution of vehicles types or road safety (Luoma & Sivak, 2007 *in* Zhang, Tsimhoni, Sivak and Flannagan, 2010). Although it is not recent, one official source, the Asian Development Bank, estimated in 2009 that E2W ownership in 2007 was between 33 million and 45 million (Feng, Jiang, et al., 2007; Zhejiang Bike Web 2007). Moreover, in

2010, the estimated total number of E2W was over 120 million (Xinhua news, 2010 *in* Wu, Yao, Zhang, 2011). It should also be noted that no category for E2W in the National Statistics Bureau data set exists. Therefore, it is difficult to determine whether E2W are counted as bicycles or small utilitarian motorcycles (which could include mopeds) or not counted at all since registration requirements differ from one city to another. Most importantly, the growth development in China of E2W is expected to keep increasing substantially, notably as a result of the progressive banishment in some Chinese municipalities of the LGP (Liquefied Petroleum Gas) and motor gasoline two-wheelers. In 2004, 13,655 regular bicycle riders died and 54,286 were seriously injured in road accidents. These statistic figures represent 12.8% of all traffic fatalities and 11.3% of injuries (CRTASR, 2004 *in* Wu, Yao, Zhang, 2011). Traffic safety for E2W riders is considered as an even more severe problem since the number of fatalities and injuries has increased dramatically over the past few years. In 2004, 589 E2W riders died and 5,295 were seriously injured. The corresponding figures increased to 2,469 and 16,468, respectively in 2007 (CRTASR, 2007 *in* Wu, Yao, Zhang, 2011). All in all, local views about E2W are quite ambivalent (Cherry, 2007) considering the current state of a growing crisis of unsafe roads that boasts a mortality rate four to five times higher than in other nations. It is in this general context that the *Road Traffic Safety Law of the People's Republic of China*[iii] was established in 2003 to function as the first Chinese law on road traffic safety and address the alarmingly high traffic fatality rate. Opponents of E2W often cite the number of deaths as proof of dangerousness, while others consider that this reflects their vulnerability (Cherry, 2007). Whether dangerous or vulnerable, a deeper knowledge on risk factors of E2W and their accident involvement is required, especially in the Chinese road context.

General statements from the literature

Generally speaking, we can state from the Western literature that road traffic involves various users with different designs of vehicles (E2W, PTW, cars, etc) as well as various driving styles that result from the physical and dynamic characteristics of these vehicles. All these elements are likely to lead to interaction management difficulties between these users, notably between Powered Two-Wheelers riders and car drivers (Crundall et al., 2008; Hancock et al., 1990; Hole et al., 1996; Horswill et al., 2005; Jaffard & Van Elslande, 2010; Obenski, 1994; Van Elslande, 2002;). Two explanations are the potential mutual misunderstanding or ignorance of the determinants in the driving situation as well as the difficulties in taking others into account. These explanations encompass various practices among users which can be related to the physical and dynamic characteristics of their vehicle and their level of familiarity with other users (Brooks & Guppy, 1990; Comelli et al., 2008; Crundall et al. 2008; Crundall et al., 2012; Magazzù et al., 2006; Mundutéguy & Ragot-Court, 2011; Ragot-Court et al. 2011; Shahar et al., 2012; Weber & Otte, 1980).

E2W present numerous differences from other vehicles in terms of features, dynamic behavior, and the driving styles they entails. Thus the current increase of E2W will gradually but undoubtedly change the dynamics of road interaction in France and it is reasonable to state that they already have a significant impact on trafic interaction in China. Regarding what is known about the differential that PTW beget within the traffic system, and contributing to the vulnerability of their users and subsequent risk to other road users interacting with them, it is worthwhile to consider the effects of this specific differential and the risk factors generated. A myriad of determinants contribute to two-wheeled vehicles' higher rate of accidents. In particular, the relative scarcity of two-wheeled vehicles compared to cars, their narrow facial gauge, their speed and acceleration capacities, their poor maneuverability in emergency situations, and the specific behaviors that their drivers are

likely to adopt (riding between lanes in traffic jams, driving in emergency lanes or bus lanes, weaving through the traffic, overtaking by the right side, etc.) all contribute to their low detectability which can create unpredictable effects that lead to accidents (Ragot-Court et al., 2012; Van Elslande et al., 2008). Although a technical or mechanical perspective prevails for addressing road safety issues related to two-wheelers, some psychosocial determinants of behaviors by PTW drivers have already been identified in the analysis of their interactions (leading to an accident or not) . We can mention as for examples, an overconfidence about personal driving abilities, an overconfidence regarding the reliability of the vehicle driven (which may be associated with a misconception of the dynamic properties of this vehicle), a rigid attachment to the "give way" road regulation, a deficit of compliance to the traffic regulations rules (including moped), and an underestimation of risk inherent to personal driving. The literature also offers insight of potential risks elicited by individuals interacting with PTW: Erroneous evaluations made by car drivers in traffic situations involving a two-wheelers, faulty prognostics of changing circumstances, and inadequate considerations or absence of consideration about two-wheelers resulting from default of knowledge (Ragot & Mundutéguy, 2008, 2009; Ragot-Court & Van Elslande, 2011).

Despite this general statement that might apply to various countries, we must highlight the unique details of the Chinese road context that deviate from the western countries. First off, E2W are relatively absent from the road landscape in Europe considering PTW still account for less than 2% of all road traffic in term of kilometers driven. Another difference with EU countries is that the vehicles fleet consists of heavily-loaded trucks and many non-licensed motorcycles, and a large number of pedestrians (Zhang, Tsimhoni, Sivak and Flannagan, 2010). Shi, Bai, Ying and Atchley (2010) explain that since 2000, due to the increase of urbanization and motorization in China, Chinese traffic has been impacted by a massive

influx of new drivers with varied driving experience. The authors point out that due to economic and historical explanations, weak driver training and unfamiliarity with road safety rules exist. They add that after years of cycling (traditional mode), the abrupt transition to motorized mode has generated safety problems. While there are some distinctions between the two modes regarding restrictions of traffic lanes and different priority rules, Shi, Bai, Ying and Atchley assume that some drivers would reproduce the same behaviors as those practiced by bike. Thus, the settlement of the road regulations regarding infrastructures and driver training in China are still quite new and under progress. A final Chinese road characteristic regards the peculiar classification of vehicles. According to traffic laws in China, both E2W and regular bicycles are classified as non-motor vehicles despite having great differences in physical performance. Moreover, both E2W and regular bicycles are operated in the same lanes and are subjected to the same traffic rules. However, most E2W on the road exceed the performance limits of the national standard and travel much faster than regular bicycles (Weinert et al., 2007; *in* Wu, Yao, Zhang, 2011). All in all, these statements argue for the expectation of far more diverse driving behaviors in China, with associated risks to this diversity, compared to what can be observed so far in European countries such France. However, the road network in France is becoming more diverse, especially under economic and environmental considerations. More soft modes of transportation arise in the trafic. Jointly, more incentives towards electric vehicle propulsion are set on. Thus, conducting research in the field of Chinese road trafic should be considered as serving immediate needs of prevention in China and as a prospective approach for France. Under this consideration, implementing research studies in China appears to be more relevant in order to characterize E2W driving behaviors in the most comprehensive manner possible.

Critical review of existing definitions and items scales regarding risky driving behaviors

The general description of the Chinese road context and its peculiarities previously elicited serves as a foundation to assess the literature. Aiming to find out what is called a risky driving behavior in regards to two-wheelers, we review how a definition is made and how it is turned into multiple item measurement scales for implementations in China.. At first a search query on Sciencedirect provides insight on the still needed publications on the topic of road safety in China at not only an international stage, but also under the social and psychological sciences approaches. A search request using "China" and "road safety" as keywords to look for in "abstract, keywords, and title" yields 19 publications results. The former publication is dated only from 2006. Within these results, targeting "two-wheelers" brings only one paper[iv]. Using "cycle" instead, only brings 9 papers. These searches reveal that in regards to dangerous driving behaviors, including two-wheelers riders, research studies focus on three specific driving behaviors: helmet use, red-light running and speed behaviors. Secondly, to fulfill our goal of defining risky driving behaviors for two-wheelers, we opened up our search with no limitations to also include cars as vehicles.

This search referred us to Xie and Parker (2002) who relevantly point out that some disctinct Chinese cultural, personality, and attitudinal factors might also play a role on accident risk. Additionally, they mention that some classical demographic factors have been shown to carry differing impacts compared to Western populations. In this paper the authors aim to deal with driving behaviors in two Chinese cities and their involvement with traffic accidents. The driving behaviors they focus on are first mentioned as "aberrant driving behaviors," then as "aggressive violations," as "driving violations," and finally "intentional driving violations." As no definition is provided, these designations can be understood as interchangeable. In this paper, traffic road violations are both understood as intentional and aggressive. For the

purpose of their study, Xie and Parker (2002) make use of the Manchester Driver Behaviour Questionnaire (DBQ) initially developed by Parker, Reason, Manstead and Stradling (1995) for Westerner drivers population. According to the DBQ items, the risk linked to traffic accident occurences is strictly operationalized as violations, lapses, and errors. References to the road regulation are obvious. Based on the DBQ, Xie and Parker develop the Chinese Driving Questionnaire (CDQ). It covers culture-specific topics that emerged from interviews and literature reviews. Respondents express their agreement with 40 statements related to the importance of social hierarchy, the road safety measures, attempts to escape the sanctions, and the questioning of the lawful authority by some drivers who first think first of their own interests rather than safety. Additionally to the development of the CDQ, the authors added an extended set of driving violations relevant in China. This extended version of the DBQ refines categories as errors and lapses, aggressive violations, lane-use, inattention errors, maintaining progression violations, and signaling of impatience. Through scrutinizing these factor labels, one can question why this idea of (intentional) aggression only appears in the second violation factorial items group and not in another one. It appears as quite debatable for many of these items: “Chase a driver who angered you,” “Get involved in unofficial races,” “Race away from traffic lights,” “Overtake on the inside,” “Break speed limit,” “Drink and drive,” and “Show an aversion to other road users.” When even the DBQ itself is noticed as the “DBQ aggressive violation scale,” we defend that those driving behaviors are over-interpreted as intentional aggression. Since contextualization of the driving situation often lacks in these items, it makes them imprecise. As an example, “Race away from traffic lights” can correspond to a judgmental or perception error as well as an intentional aggression. Another example is “Break speed limit.” Instead of a willingness to appear aggressive to another driver, the action could correspond to a sensation seeking need. In this regard, Xie and Parker themselves mention in discussion about variability of the results according to age

of the sample, a study of sensation seeking in a Chinese sample by Wang et al. (2000). Beyond an aggressive intention, Shi et al. (2010), referring to Xie and Parker, describe this driving behavior as an emotional response instead.

Finally, this above critical analysis brings us to defend a methodological point of view. Any intentional aggressiveness, ignorance, sensation seeking, personality influence, cognitive, social, or cultural factors, or any explanatory factors of traffic rules violations should be independently measured from the (risky) driving behaviors themselves. Reducing violations items to intentional aggression motives represents a restrictive or bias approach that does not allow investigation on further explanatory factors.

More recently, Shi, Bai, Ying and Atchley (2010), conducted a study among Chinese drivers in Beijing city. The authors sought to understand the nature of aberrant driving behaviors. Despite a lack of definition, since the authors refer to Reason et al. (1990) it is clear that these behaviors must be understood as violations (intentional) and errors (non-intentional behaviors). They aim to compare self-reported driving behaviors of Chinese new set of car drivers with those that we know in the West. Rather than make use of current tools used in Western countries, the authors highlight the need to develop a "localized Chinese and standardized version of the DBQ" to be applied everywhere in China. They acknowledge Xie and Parker's (2002) CDQ development and its combination with the DBQ as an excellent innovation for discovering new predictors. Nevertheless, they argue that these predictors may have changed in the last decade. Their point of view is that "interpersonal network" and "social hierarchy," which are the two most important factors in the CDQ, are no longer valid for the new generation of Chinese drivers. The authors also assume that the increased number of drivers who switch from bicycle to car should generate the identification of more "self-willed" behavior from these new drivers. Therefore, Shi et al. take the opportunity to develop

an updated tool. All in all, this new measure incorporates about 25 items of violations and errors. Six items from the extended DBQ (Xie & Parker. 2002) and nine from the original DBQ (Reason et al. 1990) having been shown to be related to accidents are included. Ten new items are designed from prior interviews. Factor analysis reveals five factors: "Emotional Violation," "Risky Violation," "Distracted Error," "Self-willed Violation," and "Inexperience Violation/Error." Interestingly for our purpose, with the exception of "Inexperience Violation/Error," all these violation factors are assumed as deliberate, intentional behaviors. Debate ensues when reading some items that lack of context to determine whether the behavior is intentional or not. The disparity between items for each factor creates ambiguity regarding categorization. Furthermore, errors are presupposed to be due to distraction or inexperience. Yet errors while driving are not that restricted. For example, failure to notice a pedestrian crossing can sometimes be due to the low cognitive conspicuity of pedestrians.

Finally, Cheng and Ng (2010) appear as the only researchers to focus on Chinese motorcylists. To properly explore this realm, they could have develop an adaptation of the Motorcyclists' Riding Behavior Questionnaire (MRBQ, Elliott et al, 2007; Özkan et al. 2011). Distinctively, the MRBQ is only dedicated to motorized two-wheelers while the DBQ and the CDQ questionnaire focus on car drivers. The MRBQ reveals that motorcyclist behavior corresponds to a five-factor structured model: traffic errors, control errors, speed violations, performance of stunts, and use of safety equipment. However, the MRBQ, as among other current measures, has been developed in Western countries and mainly in the English language. Cheng and Ng share Xie and Parker (2002) as Shi et al. (2010) 's point of view (2002) that contextual factors in terms of social, cultural, and traffic environments could also influence the driving behavior of Chinese drivers, especially their tendencies of

violation. Hence, they argued the need for an *ad hoc* measure to evaluate driving violations of motorcycles in China. They aimed to "locally develop" such a questionnaire. With these objectives in mind, they designed the Chinese Motorcycle Rider Driving Violation (CMRDV) scale. It consists of 19 items. The purpose is to assess the driving violations of Chinese motorcycle riders and evaluate its screening accuracy between accident-involved and accident-free motorcycle riders. Nevertheless, one could counter-argue that the authors' goal is not yet fully actualized. Indeed, in China the idea of "locally developed" can suffer some significant regional differences, even cultural ones. In Cheng and Ng's paper, Chinese riders are clearly quoted as from mainland China, Taiwan, and Hong Kong. However, the methodologies of the scale development and the test phases have been exclusively driven in Hong-Kong. A working group including a principal motorcycle driving instructor from the Hong Kong School of Motoring, a commercial motorcycle accident avoidance instructor, a high experienced licensed motorcycle rider, and two expert instructors have been involved for the CMRDV items generation. A final sample of 680 Hong Kong riders of motorcycles with an engine capacity between 50cc and 250cc composed the population for the test of the full survey questionnaire. The items of the CMRDV are designed in traditional characters and some of them are expressed in a typically Cantonese way of oral talking. Such a detail appears relevant since despite the fact that official languages are English and Chinese (Mandarin or *Putong hua*), Cantonese (or *Guangdong hua*) is acknowledged as the *de facto* official spoken variety of Chinese language in Hong Kong. In fact, 97% of the population in Hong Kong speaks Cantonese and it is the main variety of Chinese language used in education, broadcasting, government administration, legislature and judiciary as well as in daily social communication. However, in Mainland China Mandarin dominates. That makes a significant difference in the selection of a tool to measure driving behaviors. Additionally, it should be disclosed that some differences exist between Mainland China and its Special

Administrative Regions regarding the level of traffic regulations, the advancement of the road infrastructure, and traffic directions. People drive on the left side in Hong-Kong and Macau while on the right side in Taiwan and Mainland China. Therefore it seems quite premature to reach the conclusion, as claimed by the authors, that the CMRDV can be applied to any Chinese Motorcycles riders driving behaviors. Also, unlike most studies, Cheng and Ng do not take into account the very wide diversity of motorcyclists in their data analysis and comments (Mundutéguy & Ragot-Court, 2011). Indeed, their sample gathers riders of vehicles with engines between 50cc and 250cc, which covers a range of differences regarding physical and dynamics properties. After all, electric two-wheelers themselves can be scooter or bike styles. However, no data analyses are introduced under this distinctive feature. Finally, the authors do not include in their sample riders with less than three years of experience with two-wheelers. While two-wheelers new drivers have distinctive driving behaviors and an higher accident records according to the Western literature, one could question the representativeness of the results. Furthermore it has been shown that there is a higher risk of young motorcyclists getting involved in accidents, including those of high severity (Huang & Preston, 2004; Kraus et al, 1976 ; Mullin et al, 2000 ; Nakahara et al, 2005 ; Yannis et al, 2005; Zambon, & Hasselberg, 2006a). Even if driving experience is also a significant factor to explain accidents, (Sexton et al., 2004) young age is a factor that comes first (Taylor & Lockwood, 1990). Rutter and Quine (1996) illustrate through the identification of the willingness among young people to break the law and violate rules of the road traffic.

Towards a more comprehensive definition of risky driving behaviour

Following our review of the literature, our main statement is that there is currently no available definition about what constitutes risky or dangerous driving behaviour for two-

wheelers, either electric or not, both for Chinese and Western studies. Generally, literature about driving behaviors, as linked to road accidents, does not provide a formal definition. Even more, there are no standard designations between different research papers or within any one research paper. “Aberrant driving behavior,” “intentional driving violation,” and “interpersonal aggressive violation” are alternatively, and even confoundingly, mentioned to designated driving behaviors related to accidents. Our observation is consistent with the systematic content analysis presented by Dula & Geller (2003). Following the objective to clarify imprecise definitions of what comprise dangerous driving behaviors, the authors suggest that dangerous driving behaviors are ones that endanger or potentially endanger others. They identify three main categories of dangerous driving behaviors: (a) intentional acts of bodily and/or psychological aggression toward other drivers, passengers, and/or pedestrians (acts may be physical, gestural, and/or verbal in nature); (b) negative emotions felt while driving (including frustration, anger and rage, but which might also include sadness, frustration, dejection, jealousy, etc.); and (c) risk-taking behaviors defined as dangerous behaviors performed without intent to harm self or others. This third classification includes such behaviors as speeding, general tailgating, running red lights, weaving through traffic, maneuvring without signaling, and frequent lane changing.

Following our goal to characterize risky driving behaviors of electric-two wheelers, first in the Chinese road context, we suggest reliance on Dula and Geller third level definition of dangerous behaviors. Once reformulated, it follows: *One driving behavior is risky if it (potentially) puts in danger oneself or endangers others in the traffic system, out of self/hetero aggressiveness and out of negative emotions felt while driving.* The adoption of this definition will allow us to go beyond the usual violations/aggressive intention and errors approaches of aberrant driving behaviors as they relate to accidents, especially when it is debatable that these last ones can be procurred through self-reported method. The interest is

to further explore factors that explain these dangerous driving behaviors. These exploration would include a separate measure of aggression intention as an explanatory factor among others. Already some individual and personality trait factors have been explored, such as the well-known sensation seeking trait. However, social, psychological, and cultural factors still warrant investigation.

We also demonstrated no available measure exists that sufficiently gathers the features of measuring risky driving behaviors of two-wheelers without neglecting the specifics of the vehicle driven (type and categories of two-wheelers for example), and additionally being "locally" adapted to the Mainland China traffic road context and therefore in the Chinese language (meaning Mandarin). A continuation of our ongoing research program will entail the development of this still missing self-reported questionnaire according to the definition of risky driving behaviors we introduced. Moreover, according to the peculiarities of the Chinese road context (road sharing between drivers with and without driving licenses as well as the recent modal shift of often non-motorized to motorized vehicles for drivers of various ages), we think the design of such a tool should avoid any driving regulations references in the risk-taking behaviors items.

Conclusion

In this paper, we explained how Electric Two-Wheelers vehicles have not yet been characterized, despite being sold at a break-neck pace. This is largely due to China's booming market. Since this phenomenon coincides with a high rate of E2W riders' mortality, futures research studies should embrace the goal to develop innovative knowledge in this field. Allowing the creation of preventative guidelines, or prospective guidelines in countries where this type of vehicles only starts emerging, is vital. Our current international collaborative research project contributes to this broad objective.

Generally speaking, aspects related to human factors in road safety issues are still lacking in China. Thus the approach we suggest is valuable since it allows going beyond the technical and mechanical components concerning the general question of urban mobility. Our critical review introduced in this paper provides a first step. We defend the need to take the specifics of the local context and the evolution of transport mobility into account during the investigation of driving behaviors. Finally, the development of an ad hoc tool to measure risky driving behaviors of the two-wheelers in China shall be readily applied to in emerging countries or European countries in the future.

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Footnotes

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