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*How to measure risky driving behaviours of electric and motorized two-wheelers in China? A critical review of current existing tools used towards Chinese drivers*

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Abstract:

Today, Chinese people rely heavily on Electric Two-Wheelers (E2W) both the scooter and the bike styles (Cherry & Cervero, 2007). Together with the Motorized two wheelers (M2W) that would sooner or later be excluded from the road traffic in some big Chinese cities, their production keeps growing (Asian Development Bank, 2009) This phenomenon is going along with a high rank of E2W riders' mortality. However, understanding of the factors that could explain their accident involvement is still needed. Studies to improve this knowledge are far from being numerous enough. Adopting this objective, we launch a research program which aim to improve specific knowledge about the risk of E2W compared to M2W riders in Shanghai. We adopt a social-cognitive psychological approach and we follow urban planning concerns. As a first stage of this research work, we first review the literature aiming to find out what definition is made of dangerous/risky driving behaviors and how there are measured in the Chinese road context. That lead us here to critically report the currently used tools in regards to both cars and two-wheelers dangerous/aberrant/violations driving behaviours. We point out a general lack of definition of the label of violation and that there is actually no formalized definition of risky driving behaviours. 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 to only refer to Dula & Geller (2003) sole definition of risky driving behaviours in order to be operationalized into items dedicated to E2W and M2W riders.

*Keywords* Driving behaviours, risk, electric-two-wheelers riders, motorized-two-wheelers riders, China, social-cognitive psychologist approach

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### *Introduction*

From Europe, the mode of transport that is so stereotypical China remains the human powered two-wheelers i.e. the bicycle. However, the road landscape diversifies and Electric two-wheelers (E2W or electric bike) have emerged as a popular mode of transportation in many large cities during recent years (Weinert and al., 2007). Actually they compose the main part of the two-wheeled traffic beside regular bicycles. It is not easy to have clear statistic data about the distribution of vehicles types as well as about road safety in China and in many other developing countries (Luoma & Sivak, 2007 in Zhang, Tsimhoni, Sivak and Flannagan, 2010). One official source even though it is not that quite recent, 2009, is the Asian Development Bank with its report titled “*Electric bikes in the People’s Republic of China: impact on the environment and prospects for growth*”. There, statistics features report E2W ownership as estimated in 2007 to be between 33 million and 45 million (Feng, Jiang, et al., 2007; Zhejiang Bike Web 2007). More recently the estimated total number of E2W was over 120 million in 2010 (Xinhua news, 2010 in Wu, Yao, Zhang, 2011). Motorcycles ownership in the PRC reached 80 million by 2005 (National Bureau of Statistics 2007) and there are around 460 million bicycles and 13 million cars. In this Asian bank development bank report, it is underlined then that there is no category for E2W in the National Statistics Bureau data set. 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 city to city. Most importantly, the growth development in China of E2W is expected to keep going notably. For instance in Shanghai, the LPG two-wheelers (Liquefied Petroleum Gas) which were still 288 000 in 2009, will in 2013 be banned. Since 2003, this has been already the case for the motor gasoline two-wheelers. This displacement mode is closely related to considerations of urban planning. With the expansion of cities, the decline of peri-urban areas and the increasing congestion of roads, the appeal for E2W is that it allows travelling long distances at low cost. In this context, Wu, Yao, and Zhang (2011) report that Chinese government agencies are showing an increasing interest in promoting two-wheeled traffic. But this growing popularity of two-wheeled traffic is not without safety concerns. 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 5295 were seriously injured. The corresponding figures increased to 2469 and 16,468, respectively in 2007 (CRTASR, 2007 in Wu, Yao, Zhang, 2011). To sum up local views about E2W are quite ambivalent (Cherry, 2007) as the general context is of a growing crisis of unsafe roads with 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*<sup>1</sup> has been stated in 2003; the Chinese first-ever law on road traffic safety. It was intended to address this 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). Either dangerous and/or vulnerable, a deeper knowledge on risk factors of both E2W and

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<sup>1</sup> [http://english.gov.cn/laws/2005-09/07/content\\_29966.htm](http://english.gov.cn/laws/2005-09/07/content_29966.htm)

M2W riders and their accident involvement is required and more specifically in the Chinese context.

Adopting this objective, we launch a research program which aims to improve specific knowledge about the risk of E2W riders in China under a social-cognitive psychologist approach and in comparison with M2W. In this paper, and as a first stage of this program, we refer to general statements and Chinese specificities regarding traffic road context and vehicles' interactions. Then we classically refer to the literature in order to answer the question "what is called a risky driving behaviors as a two-wheelers?" and "how are they actually measured in the Chinese traffic road context?". We reviewed both how a definition is made and how it is operationalized into items. That lead us to critically examine currently exploited tools in China about both cars and two-wheelers related to dangerous driving behaviours: 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).

*General statements and Chinese specificities regarding traffic road context and vehicles' interactions*

Generally speaking, we can state from the Western literature that the traffic road involves various users with different designs of vehicles (E2W, M2W, cars...) as various driving styles that result from the physical and dynamic characteristics of these vehicles. All these elements lead to difficulties in terms of interactions management between these users, notably between power two-wheelers riders and car drivers (Hole et al., 1996; Horswill et al., 2005; Crundall et al., 2008; Hancock et al., 1990; Obenski, 1994; Van Elslande, 2002; Jaffard and Van Elslande, in press). Two explanations are the potential mutual misunderstanding or ignorance of the driving situation's determinants and difficulties in taking others into account. These include 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 (Ragot-Court et al. 2011; Mundutéguy & Ragot-Court, 2011; Crundall et al., in press; Shahar et al., in press; Comelli et al., 2008; Magazzù et al., 2006; Weber and Otte, 1980; Brooks and Guppy, 1990; Crundall et al. 2008). Over this general statement that might be quite common to different countries we have to highlight the specificities of the Chinese road context as at least different from the western countries. First in Europe, EW2 are almost absent from the road landscape and M2W still account for less than 2% of all road traffic in term of kilometers driven! Other strong differences with EU countries exist about the vehicles fleet: heavily-loaded trucks, many non-licensed motorcycles, and a large number of pedestrians (Zhang, Tsimhoni, Sivak and Flanagan, 2010). Shi, Bai, Ying and Atchley (2010) explain that since 2000 due to the increase of urbanization and motorization in China, the Chinese road traffic receives a massive additional numbers of new drivers with varied driving experience on road in China. They point out the weakness of driver training and the unfamiliarity with road safety and the rules for economic and historical causes. They claim that after years of cycling (traditional mode), the abrupt transition to motorized mode is able to generate safety problems. Indeed, there are some distinctions between the two modes regarding restrictions of traffic lanes, different priority rules etc. The authors assume that some drivers would reproduce the same behavior as those practiced by bike such as stopping anywhere and anyway. To sum up, the road regulations, the infrastructures and the fleet of vehicles are in China not yet stable. It's also the case about the driving trainings conditions. Finally, another Chinese characteristic of the road is that according to traffic laws in China, and though having great differences in

physical performance, both E2W and regular bicycles are classified as non-motor vehicles. 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 expected differences between users in China and Western countries in term of driving behaviours and consequently of risky driving behaviors as well.

*Critical review of literature: which definitions and which measures are made of risky driving behaviours on the Chinese road context?*

Now that we described the Chinese road context and stated its peculiarities, we keep it as a general background to assess the literature. We critically review recent research studies implemented in China aiming to find out “what is called a risky driving behaviors as a two-wheelers?” We review both how a definition is made and how it is turned into items for implementations in China. First a simple research on Scencedirect gives us a glance on the still needed research publications 1/at an international level 2/on the field of safety road in China 3/under the social and psychological sciences approaches. Indeed, a search using “China” and “safety road” as keywords to look for in abstract, keywords, and title brings 19 publications as a results. The former one is dated from 2006! Then a search within results targeting “two-wheelers” brings only one paper<sup>2</sup>! Targeting “cycle” instead, only brings 9 additional papers. It informs that concerning dangerous driving behaviors including the ones of two-wheelers riders, research studies focus on three specific driving behaviors: helmet use, red-light running and speed behaviors. Then, to fulfil our goal for giving a definition to risky driving behaviors as two-wheelers, we opened up our search with no limitations to two-wheelers but including also cars.

First, we refer to Xie and Parker (2002) who relevantly point out that some Chinese cultural factors, personality factors and attitudinal factors as well might play a role on accident risk distinctively from other cultures. Additionally, they mention for example that some classical demographic factors have been shown to have a different weight or none 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. These 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. Here considered traffic road violations are understood both 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 the Western drivers. Then one shall be stated that according to the items of this tool the risk as linked to traffic accident is here strictly operationalized as violations, lapses and errors. Then, references to the road’s regulation are obvious. Based on the DBQ, the authors develop the Chinese Driving Questionnaire (CDQ). This covers culture-specific topics that emerged from interviews and literature review. Respondents express their agreement with 40 statements related to the importance of social hierarchy, the road safety measures, and attempts to escape

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<sup>2</sup> Changxu Wu, Lin Yao, Kan Zhang, The red-light running behavior of electric bike riders and cyclists at urban intersections in China: An observational study, *Accident Analysis & Prevention*, Available online 2 July 2011, ISSN 0001-4575, 10.1016/j.aap.2011.06.001.  
(<http://www.sciencedirect.com/science/article/pii/S0001457511001679>)

the sanctions, the questioning of the lawful authority by some drivers who think first to their own interests rather than safety. Additionally to the development of the CDQ, the authors add to the DBQ an extended set of driving violations relevant in China. Then this extended version of the DBQ refines categories as errors and lapses, aggressive violations, lane-use, inattention errors, maintaining progression violations, and signalling of impatience. Having a closer look on these factor labels one can question why this idea of (intentional) aggression is only enlighten in this second violation factorial items group and not in another one. It appears as quite debatable for main 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", "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 like 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" besides an intentional aggression can otherwise correspond to a judgmental/perception errors. Another example "Break speed limit" instead of a willingness to show one-self aggressive to another could respond to one sensation seeking need. In this regard, Xie and Parker themselves mention in discussion about results variability according to age of the sample, a study of sensation seeking in a Chinese sample by Wang et al. (2000). Otherwise it could be an overuse of the concept of aggressiveness as Shi et al. (2010) referring to Xie and Parker describe it as emotional instead. Finally, this above critical analysis brings us to defend a methodological point of view. Either intentional aggressiveness, ignorance, sensation seeking, or whatever personality, cognitive, social or cultural factors, any explanatory factors of traffic rules violations should be independently measure from the (risky) driving behaviors themselves. Confounding violations items to intentional aggression motives is a restrictive or bias approach that does not allow investigating on further explanatory factors.

More recently, Shi, Bai, Ying and Atchley (2010) that we mentioned before, drove a study among Chinese drivers as well (Beijing city). The authors aim to understand the nature of aberrant driving behaviors. Despite a lack of definition, as 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 among the new set of car drivers, self-reported driving behaviors of Chinese people with those that we know in the West. Rather than make use of currently used tools 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 as an excellent innovation Xie and Parker (2002) CDQ development as its combination with the DBQ 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 lead to the finding of more "self-willed" behaviour from these new drivers. Therefore, Shi and al. take the opportunity to develop an updated tool. All in all this is about 25 items of violations and errors. Six items from the extended DBQ (Xie et 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, except "inexperience Violation/Error", all these violation factors are assumed as deliberate, intentional behaviors. It appears to be debatable when reading some items lacking of contextualization to determine



whether the behavior is intentional or not. The disparity of items for each factor blurs a tentative of categorization by the authors. Furthermore, errors are presupposed to be due to the distraction or from inexperience. But errors while driving are not that restricted. Fail to notice a pedestrian crossing can sometimes be due to the low cognitive conspicuity of pedestrians.

Finally, Cheng and Ng (2010) seem to be the only one to focus on Motorcycle Chinese riders. They could develop for example an adaptation of the Motorcyclists' Riding Behavior Questionnaire (MRBQ, Özkan & al. 2011; Elliott & al, 2007). Distinctively, the MRBQ is only dedicated to motorized two-wheelers when the DBQ, the CDQ and recently Shi et al. (2010) questionnaire focus on car drivers. The MRBQ reveals that motorcycle riders behaviours respond to a five-factor structured model: traffic errors, control errors, speed violations, performance of stunts and use of safety equipment. But the MRBQ as among other current tools has been developed in Western countries and mainly in 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 tendency to violate. Hence, they argued the need for an *ad hoc* measure to evaluate driving violations of motorcycles in China. They aim to "locally develop" a questionnaire. Finally, they design the Chinese Motorcycle Rider Driving Violation (CMRDV) scale. It consists of 19 items. The intent 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 authors' goal is not yet fully reached here. 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. First, 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. Then, a final sample of 680 Hong Kong riders of motorcycles with an engine capacity between 50 and 250 cc composed the population for the test of the full survey questionnaire. Therefore, the items of the CMRDV are designed in traditional characters and some of them are so typically Cantonese way of oral talking. That appears relevant despite the fact that official languages are English and Chinese (Mandarin or *Putong hua*), however Cantonese (or *Guangdong hua*) is acknowledged as the *de facto* official spoken variety of Chinese language in Hong Kong. To make it clear, 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 non-negligible differences features in the choice of a tool for the measurement of driving behaviors. Additionally, it shall be mentioned some differences between Mainland China and its Special Administrative Regions regarding the level of traffic regulations, the advancement of the road infrastructure and regarding 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 to us quite premature to reach the conclusion as claimed by the authors that the CMRDV can be applied to any Chinese Motorcycles riders driving behaviors. Besides, as usual in most of studies, Cheng and Ng here do not take into account the very wide diversity of motorcyclists in their data analysis and comments (Mundutéguy and 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. Electric two-wheelers themselves can be scooter or bike styles. But 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 and narrow to expert riders for the generation of items. Then one could put in question the representativeness of the results while two-wheelers new drivers have distinctive driving behaviors and a high accident record rate according to the Western literature. Furthermore it has been shown a higher risk for young motorcyclists for getting involved in accident and moreover those of high severity (Yannis & al, 2005; Nakahara & al, 2005 ; Kraus & al, 1976 ; Huang & Preston, 2004 ; Mullin & al, 2000 ; Zambon, & Hasselberg, 2006a). Even if driving experience is also a significant factor to explain accident (Sexton et al., 2004) young age comes first (Taylor & Lockwood, 1990). Rutter and Quine (1996) give as an example one willingness among young people to break the law and violate rules of the road traffic.

#### *Towards a more comprehensive definition of risky driving behaviour*

Our main statement is that there is currently no available definition about what is a risky or dangerous driving behaviour as two-wheelers, 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 one research paper itself. "Aberrant driving behavior", "intentional driving violation", "interpersonal aggressive violation" are alternatively and even confoundedly mentioned to designate driving behaviours as linked to accidents. Our observation is consistent with Dula & Geller (2003) systematic content analysis. Following the objective to clarify imprecise lines definitions of what are dangerous driving behaviours, the authors suggest that dangerous driving behaviors embrace those that put in danger or potentially in danger the others. They identify in the literature 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 behaviours performed without intent to harm self or others. This third class includes such behaviours as speeding, general tailgating, running red lights, weaving through traffic, manoeuvring without signalling, and frequent lane changing. Following our goal to measure risky driving behaviors of both electric-two wheelers and motorized-two wheelers in the Chinese road context, we suggest to be based on Dula and Geller third level definition of dangerous behaviors. *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.* We think that adopting this definition will allow to go beyond the violations/aggressive intention and errors' usual reading approaches of aberrant driving behaviours related to accidents, moreover when it is debatable that these last ones can be seized through self-reported method. The interest is to explore further explanatory factors of these dangerous driving behaviours including aggression intention as it can be measured separately, as other explanatory factors. Already some individual, personality trait factors have been explored as the well-known sensation seeking trait, but social psychological and cultural factors still need to be investigated. We demonstrated there is currently no satisfying available measure that gathers the features of 1/ measuring risky driving behaviors of two-wheelers without neglecting the specificities of the vehicle driven (type and categories of two-wheelers for example), 2/ being "locally" adapted to the Mainland China traffic road context and 3/ therefore in Chinese language (meaning Mandarin). A continuation then should be the development of this still missing self-reported questionnaire according to the definition of

risky driving behaviors we introduced. Plus, according to the peculiarities of the Chinese road context (as roads shared between drivers with and without driving license and, recent modal shift from one type -often non-motorized- of vehicles to another motorized ones for drivers of various ages), we think such a tool should avoid any driving regulations references in the design of risk-taking behaviours items.

### *Conclusion*

Generally speaking aspects related to human factors in road safety issues are still lacking in China. The approach we suggest is valuable as it allows going beyond a technical and mechanical vision on the general question of urban mobility. More specifically, one aim is to contribute improving knowledge about specific risk and vulnerability factors of E2W riders and M2W riders respectively in interactions with car users. Our critical review introduced in this paper provides a first step. We defend the need to take into account the specificities of the local context and the evolution of transport mobility in the investigation of driving behaviors. Finally, the development of an ad hoc tool to measure risky driving behaviors dedicated to the two-wheelers in China shall be later quickly adapted with few modifications to others developing countries road context in Asia and then in South America. Eventually, new knowledge that would be developed under this approach should benefit to European countries. As the environmental protection motives are increasing, so are the use of M2W and E2W.

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## 2012 Upcoming Events

### October 24-28 2012

ACE2012 - The Fourth Asian Conference on Education

### November 2-4 2012

MediAsia2012 - The Third Asian Conference on Media & Mass Communication [Click Here](#)

FilmAsia2012 - The First Asian Conference on Film and Documentary

### November 16-18 2012

ABMC2012 - The Third Asian Business & Management Conference [Click Here](#)

## 2013 Upcoming Events

### Thursday March 28 - Sunday March 31, 2013

ACP2013 - The Third Asian Conference on Psychology and the Behavioral Sciences

ACERP2013 - The Third Asian Conference on Ethics, Religion and Philosophy

### Thursday April 4 - Sunday, April 7, 2013

ACAH2013 - The Fourth Asian Conference on Arts and Humanities

LibrAsia2012 - The Third Asian Conference on Literature and Librarianship

### Thursday April 25 - Sunday April 28, 2013

ACLL2013 - The Third Asian Conference on Language Learning

ACTC2013 - The Third Asian Conference on Technology in the Classroom

### Friday May 24 - Sunday May 26, 2013

ACAS2013 - The Third Asian Conference on Asian Studies

ACCS2013 - The Third Asian Conference on Cultural Studies

### Thursday June 6 - Sunday June 9, 2013

ACSS2013 - The Fourth Asian Conference on the Social Sciences

ACCS2013 - The Third Asian Conference on Sustainability, Energy and the Environment

### Wednesday October 23 - Sunday October 27, 2013

ACE2013 - The Fifth Asian Conference on Education

ACETS2012 - The First Asian Conference on Education, Technology & Society

### Friday November 8 - Sunday November 10, 2013

MediAsia2013 - The Fourth Asian Conference on Media & Mass Communication

FilmAsia2013 - The Second Asian Conference on Film and Documentary

### Friday November 22 - Sunday November 24 2012

ABMC2013 - The Fourth Asian Business & Management Conference

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