Speeding for fun? Exploring the speeding behavior of riders of heavy motorcycles using the theory of planned behavior and psychological flow theory

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1. Introduction

As a means of transport, a motorcycle is both inexpensive and easy to use, whether in the heavy traffic of large cities or in the countryside. The risks and the rate of death or injury for motorcycle riders are, however, far greater than those for other vehicle users (Chen, 2009; Savolainen and Mannering, 2007; Wong et al., 2010). A relationship between speeding behavior and accidents has been found in past studies (Chen, 2009; Iversen, 2004; Parker et al., 1998, 1996; Paris and Broucke, 2008; Pelsmacker and Janssens, 2007; Ulleberg and Rundmo, 2003; Yagil, 2001; Wong et al., 2010). Drivers’ decisions to speed have therefore been a global focus of research efforts, and these studies have provided significant insights into the speed-related decision-making process (Mannering, 2009). A deeper understanding of why motorcyclists decide to exceed the speed limit is thus crucial to changing their behavior.

The motorcycle licensing system in Taiwan is classified by engine capacity into three types: moped (less than 50cc), light motorcycle (50–250cc) and heavy motorcycle (over 250cc) (Chang and Yeh, 2007). Heavy motorcycles in general have been allowed to ride in car lanes since 2007. In addition, large-sized heavy motorcycles whose engine capacity is over 550cc have been allowed to use the restricted expressway since November 2007. Considerably different from mopeds and light motorcycles, heavy motorcycles are used for recreational use (around 67%) rather than commuting or shopping. Among the various traffic violations committed by riders of heavy motorcycles, seriously exceeding the speed limit is ranked in first place. Around 64% of heavy motorcycle riders admitted to having experience of exceeding the speed limit by over 40 kph (Ministry of Transportation and Communications, 2009). Heavy motorcycle riders are thus a part of a special group who ride for pleasure while seeking the experience of speed. Similar evidence of the fact that heavy motorcyclists are prone to speeding was found by previous studies. Mannering and Grodsky (1995) examined motorcyclist risk perception and found that over 70% of riders reported that they drove at over 100 mph on public roads, and over a third indicated that they looked forward to doing so again. Savolainen and Mannering (2007) examined the effectiveness of motorcycle training and motorcyclists’ risk-taking behavior using a sample of Indiana motorcyclists. They found that riding a sports bike is one of the main factors increasing the likelihood of exceeding 90 mph on public roads, another factor being ownership of a motorcycle with a displacement exceeding 900cc. Furthermore, riders who typically ride sports bikes were found to be more likely to be involved in an accident.

Although the speeding behavior of riders of heavy motorcycles is quite different from that of moped and light motorcycle riders, knowledge about their risky behavior is still rare compared to that of car drivers. More research efforts to gain a better understanding of the heavy motorcycle riders’ speeding behavior are thus warranted. This study aims to fill this research gap by specifically investigating the relationships between speeding behavior and its affecting factors. For simplicity, the term ‘heavy motorcycle’...
cles’ is used to represent large-sized heavy motorcycles, i.e. with an engine capacity over 250cc, and it is used in this sense hereafter throughout this paper.

A conceptual framework that has proven useful in explaining and predicting drivers’ risky behavior is Ajzen’s Theory of Planned Behavior (TPB, Ajzen, 1991). To the best of our knowledge, this paper is the first attempt to extend the TPB model to explore heavy motorcycle riders’ speeding behavior by including the variables used in psychological flow theory to capture motorcyclists’ intrinsic motivations. In addition, the levels of sensation seeking (Hansen and Breivik, 2001; Jonah, 1997; Rimmo and Aberg, 1999) and riding experiences (Liu et al., 2009; Underwood, 2007) are also used as grouping variables to investigate group differences in the influences of their affecting factors upon speeding behavior.

To investigate the interrelationships between motorcyclists’ speeding behavior and the hypothesized affecting variables (namely TPB and psychological flow variables) we employ throughout this study the technique of structural equation modeling (SEM) to answer a set of interrelated questions. SEM is a flexible linear-in-parameters multivariate statistical modeling technique that is used to explain the relationships among multiple variables, and thus is well-suited to this type of analysis. Unlike multiple regression analysis, which examines only a single relationship at a time, SEM estimates a series of separate, but interdependent, multiple regressions simultaneously. The use of SEM for traffic safety research has increased recently, and examples of such works include Chen (2009), De Pelsmacker and Janssens (2007), Sümer (2003), Ulleberg and Rundmo (2003) and Wong et al. (2010).

1.1. Theory of planned behavior (TPB)

In the field of traffic psychology many previous studies concerning drivers’ speeding behavior have used the TPB as a frame of reference (e.g. Chen, 2009; Elliott et al., 2003; Letirand and Delhomme, 2005; Parker et al., 1992; Wallen Warner and Aberg, 2006, 2008). These studies have shown that the TPB theory is, overall, able to explain and/or predict drivers’ speeding behavior (Wallen Warner and Aberg, 2008).

The TPB assumes that an individual’s behavior is reasoned, controlled, and planned, and it states that human action is guided by three types of consideration: behavioral, normative, and control beliefs. In their respective aggregates, behavioral beliefs produce a favorable or unfavorable attitude toward the behavior; normative beliefs result in a perceived social pressure or subjective norm; and control beliefs give rise to perceived behavioral control, or the perceived ease or difficulty of performing the behavior. Taken together, the attitude toward the behavior, the subjective norm, and the perceived behavioral control translate to the formation of a behavioral intention which is the immediate determinant of actual behavior. The theory states, therefore, that the attitude toward the act, subjective norm, and perceived behavioral control are indirectly linked to behavior via intention. Whether or not an intention translates into an action depends on an individual’s motivation and how much energy they are willing to invest.

1.2. Psychological flow theory

Due to the unique characteristic of heavy motorcyclists, i.e. enjoying speed as a primary motivation, this study argues that affective factors (intrinsic motivations) instead of rational factors (extrinsic motivations) might better explain and/or predict the related speeding behavior. To capture the affective factors (intrinsic motivations), the psychological flow theory – which has been used to describe a state in which people are so involved in an activity that nothing else seems to matter (Csikszentmihalyi, 1977; Csikszentmihalyi and Csikszentmihalyi, 1988) – is used in the speeding behavior model developed in this study.

Psychological flow will occur when people have the ability to overcome a problem to achieve a task with a purpose, the outcome of which is called an optimal experience. Psychological flow is a complex concept and researchers often measure it through multiple dimensions, such as perceived enjoyment, concentration, perceived control, and curiosity (Ghani and Deshpande, 1994; Koufaris, 2002; Lu et al., 2009; Moon and Kim, 2001). For example, Broughton (2006) examined the relationship between enjoyment and risky riding behavior for heavy motorcycle riders and found that the enjoyment of the riding experience, i.e. the state of flow, contributes to the tendency to engage in dangerous behavior. This study thus chooses the factors of perceived enjoyment and concentration to construct the flow of heavy motorcycle riders. Perceived enjoyment is defined as when, under conditions of playfulness, an individual will find an action intrinsically interesting, and thus will engage in it for pleasure and enjoyment rather than extrinsic rewards (Moon and Kim, 2001). Concentration is defined as when an individual loses self-consciousness, becomes absorbed in the activity, and is more intensely aware of their mental processes when in a playful state (Moon and Kim, 2001). Perceived control is not chosen, as it is similar to perceived behavioral control in the TPB model. Curiosity, referring to the case where an individual remains curious and tries to achieve technological competence while engaged in an action (Moon and Kim, 2001), is less relevant to heavy motorcycle riding experiences, and so is also excluded from this work.

1.3. Moderating variables: sensation-seeking and riding experience

Sensation-seeking refers to the tendency to desire and seek complex, varied, novel, and rapidly moving or changing sensations and experiences (e.g. Zuckerman, 1994). An individual with a greater propensity to sensation-seeking tends to seek and enjoy high stimulus, exciting, novel and diverse experiences and stimuli. High sensation-seeking is correlated to risky driving behavior. According to Schwebel et al. (2009), drivers scoring highly when measured according to sensation-seeking criteria are more likely to drive quickly, recklessly, or while intoxicated. Therefore, the current hypothesis is that there will be differences between high- and low-sensation-seeking groups in the impact of their affecting factors upon speeding behavior.

Driving experience has also been found to be an important factor affecting driver behavior (Lajunen and Summala, 1995). According to Underwood (2007), experienced drivers use sophisticated mental models of how hazardous events typically unfold over time. For a motorcyclist, a highly developed mental model may improve their ability to predict the behavior of other road users, as well as the risks associated with different riding maneuvers (Liu et al., 2009). However, in a fun-riding context, such as when using heavy motorcycles, the effect of experience on riding behavior is arguable. For example, an experienced motorcyclist might feel confident in controlling their motorcycle due to past experience when riding for speed and fun, and thus neglect the hazardous conditions. On the other hand, those who have only limited riding experience might pay more attention to the hazardous conditions when riding heavy motorcycles. Hence, this study argues that riding experience might play a moderating role in heavy motorcycle riders’ behavior.

1.4. Hypotheses

Based on the arguments outlined above, this study proposes a hypothetical model (see Fig. 1) with the following hypotheses.
**H1.** Perceived playfulness has a positive effect on attitude.

**H2.** Perceived playfulness has a positive effect on speeding behavioral intention.

**H3.** Cognitive concentration has a positive effect on attitude.

**H4.** Cognitive concentration has a positive effect on speeding behavioral intention.

**H5.** Subjective norm has a negative effect on actual speeding behavior.

**H6.** Perceived behavioral control has a positive effect on speeding behavioral intention.

**H7.** Perceived behavioral control has a positive effect on actual speeding behavior.

**H8.** Attitude has a positive effect on speeding behavioral intention.

**H9.** Speeding behavioral intention has a positive effect on actual speeding behavior.

**2. Method**

**2.1. Respondents and procedure**

This study’s sample is drawn from heavy motorcycle riding in Taiwan, and a self-administered questionnaire was used to collect data for empirical analysis, with 350 questionnaires delivered to relevant individuals based on a convenience sampling technique in February 2009. The potential participants were informed of the purpose of the survey and asked for their willingness to participate before the survey started. Only those who were willing to take part in this survey were given the questionnaires. After deleting incomplete responses, a total of 277 valid samples were obtained from the participants, yielding an effective response rate of about 80%.

The respondent data consisted of both male (87.4%) and female (12.6%) respondents. Riders aged 21–30 (53.1%) and 31–40 (29.2%) accounted for the majority of the sample. With regard to riding heavyweight motorcycles, 30% of respondents had less than a year’s experience, followed by 28.5% with 1–3 years' and 20.9% with more than 7 years' experience. The main purpose given for riding a heavy motorcycle was for recreation (82.7%).

**2.2. Measures**

The questionnaire with all constructs under investigation was designed on the basis of an extensive review of the literature. A pre-test was carried out with randomly selected heavy motorcycle riders. Based on feedback from a pilot sample of 30 riders, the survey instrument was revised to improve clarity and reliability. All constructs were measured on five-point Likert scales, ranging from 1 = “strongly disagree” to 5 = “strongly agree”, unless otherwise indicated below. Higher scores reflect higher levels of interest in that measure.

**2.2.1. Attitude toward speeding (ATS)**

Four items adapted from Aizen (2002) were used to measure respondents’ attitudes toward speeding. These items are: (1) beneficial, (2) pleasant, (3) good, and (4) acceptable, with the prompt of, “For me to exceed the speed limit when riding a heavy motorcycle would be:” scale reliability based on Cronbach’s $\alpha$ is high (i.e. $\alpha = 0.90$), and over the cut-off criterion of 0.7 recommended by Hair et al. (2006), indicating that there is a high degree of internal consistency among the four items. On average, respondents had a slightly higher than neutral attitude toward speeding behavior ($M = 3.11, SD = 1.21$).

**2.2.2. Subjective norm (SN)**

Respondents indicated whether they believed that other people who are important to them (viz., relatives and friends) would not support them speeding when riding heavy motorcycles. Three items adapted from Ajzen (2002) were framed as: “Most people who are important to me think that I should not speed when riding a heavy motorcycle”, “Most people who are important to me do not support me speeding when riding a heavy motorcycle”, and “Most people who are important to me will not speed when riding a heavy motorcycle”. The Cronbach’s $\alpha$ coefficient is 0.89, indicating a high degree of scale reliability. Lower scores indicate a greater acceptance of a social norm in favor of speeding behavior. On average, respondents thought that the social norm was to not speed ($M = 3.39, SD = 1.16$).

**2.2.3. Perceived behavioral control (PBC)**

Four items adapted from Jackson and Marsh’s (1996) FSS were used to measure respondents’ perceived difficulties in engaging in speeding. They included: “When speeding, I believe my driving skills can meet the challenge”, “When speeding, my capacity can match the high challenge of the situation”, “When speeding, I feel in total control of what I am doing”, and “When speeding, I am capable of manipulating the vehicle without thinking how to do it”. The Cronbach’s $\alpha$ coefficient is 0.94, indicating a high degree of scale reliability. Higher scores indicate greater perceived behavioral control for conducting speeding behavior. On average, respondents revealed a neutral level of perceived behavioral control ($M = 3.02, SD = 1.21$).

**2.2.4. Perceived enjoyment (PE)**

Three items adapted from Moon and Kim (2001) were used to measure perceived enjoyment, including “I find riding heavy motorcycles to be enjoyable”, “I have fun riding a heavy motorcycle”, and “The process of riding a heavy motorcycle is pleasant”. The Cronbach’s $\alpha$ coefficient is 0.97, indicating a high degree of scale reliability. Higher scores indicate a higher level of enjoyment perception of riding a heavy motorcycle, and on average the respondents revealed a neutral level of perceived enjoyment ($M = 3.02, SD = 1.4$).

**2.2.5. Concentration (CON)**

Four items from Jackson and Marsh (1996) were used to measure concentration, including “During speeding, I concentrate fully on the activity”, “During speeding, I am usually absorbed intensely in the activity”, “During speeding, I am deeply engrossed in the activity”, and “During speeding, I easily keep my mind on...
what is happening”. The Cronbach’s α coefficient is 0.95, indicating a high degree of scale reliability. Higher scores indicate a higher level of cognition concentration. On average, respondents thought that they were in a state of relatively high cognition concentration when riding heavy motorcycles (M = 3.74, SD = 1.32).

2.2.6. Speeding behavioral intention (SBI)

CFA results of the measurement model.

Table 1

2.2.8. Sensation seeking (SS)

frequently (on average the respondents revealed that they speeded relatively higher scores indicate a higher level of speeding experience, and scale ranging from “very infrequent (=1)” to “very frequent (=5)”.

Table 1

2.2.7. Actual speeding behavior (ASB)

Actual speeding behavior was measured by a single, item which was “Within the past six months, how frequently did you exceed the speed limit when riding a heavy motorcycle?”, on a five-rating was “Within the past six months, how frequently did you exceed the speed limit when riding a heavy motorcycle, I will try to speed”. The Cronbach’s coefficient is 0.91, indicating a high degree of scale reliability. Higher scores indicate a greater likelihood of engaging in speeding in the future, and on average the respondents revealed a relatively high level of speeding behavioral intention (M = 3.31, SD = 1.31).

2.2.8. Sensation seeking (SS)

Eight items adapted from Hoyle et al. (2002) Brief Sensation Seeking Scale (BSSS) were used to measure the respondent trait of sensation-seeking. These were as follows: “I would like to explore strange places”, “I would like to take off on a trip with no pre-planned routes or timetables”, “I get restless when I spend too much time at home”, “I prefer friends who are exciting and unpredictable”, “I like to do frightening things”, “I would like to try bungee jumping”, “I like wild parties”, and “I would love to have new strange places”, “I would like to take off on a trip with no pre-planned routes or timetables”, “I get restless when I spend too much time at home”, “I prefer friends who are exciting and unpredictable”, “I like to do frightening things”, “I would like to try bungee jumping”, “I like wild parties”, and “I would love to have new

Higher scores indicate a greater level of sensation-seeking traits. On average, the respondents revealed a relatively high level of sensation-seeking (M = 3.38, SD = 1.00).

2.3. Data analysis

Data were analyzed following the two-step approach to SEM suggested by Anderson and Gerbing (1988). First, a confirmatory factor analysis (CFA) was used to evaluate the psychometric properties of the measurement model to ensure that the measurement variables reliably reflected the hypothesized latent variables. Second, a structural model was estimated to determine the adequacy of the constructs of the model and test the hypotheses. Various fit indices were used to examine the structural models, as follows: goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA). According to Hair et al. (2006), values of GFI, AGFI and CFI of 0.9 or above and RMSEA of 0.05 or less indicate a good fit between the model and the data. The statistical software of LISREL 8 (Jöreskog and Sörbom, 1996) was used to analyze the data in this study.

3. Results

3.1. Confirmatory factor analysis

Before proceeding to test the structural model, we conducted for this study a confirmatory factor analysis (CFA) to test the measurement model. As shown in Table 1, goodness-of-fit indices include χ² = 624.47, df = 189 (p < 0.001), χ²/df = 3.30, RMSEA = 0.09, GFI = 0.83, CFI = 0.98, and NFI = 0.97. Most of these indices are within the threshold of recommended values mentioned above.

All of the results for composite reliability (CR), which measures the degree to which items are free from random error and therefore yield consistent results, are over 0.7, indicating that the scales have good reliability (Bagozzi and Yi, 1988). Specifically, all the standard loadings are over 0.7 and are significant at the 1% level. In addition,

Table 1

CFA results of the measurement model.

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Items</th>
<th>SFL</th>
<th>Error variance</th>
<th>Standard error</th>
<th>CR</th>
<th>AVE</th>
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</thead>
<tbody>
<tr>
<td>Perceived enjoyment (PE)</td>
<td>PE1</td>
<td>0.95</td>
<td>0.09</td>
<td>0.04</td>
<td>0.97</td>
<td>0.91</td>
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<td></td>
<td>PE2</td>
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<td>0.07</td>
<td>0.04</td>
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<tr>
<td></td>
<td>PE3</td>
<td>0.95</td>
<td>0.10</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concentration (CON)</td>
<td>CON1</td>
<td>0.93</td>
<td>0.13</td>
<td>0.05</td>
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<td></td>
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<tr>
<td></td>
<td>CON2</td>
<td>0.85</td>
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<td>0.05</td>
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<tr>
<td></td>
<td>CON3</td>
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<td>0.08</td>
<td>0.04</td>
<td>0.95</td>
<td>0.83</td>
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<td></td>
<td>CON4</td>
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<td>0.19</td>
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<td>Subjective norm (SN)</td>
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<td></td>
<td>SN2</td>
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<td>Perceived behavioral control (PBC)</td>
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<td></td>
<td>PBC2</td>
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<td>0.05</td>
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<td></td>
<td>PBC3</td>
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<td>0.94</td>
<td>0.80</td>
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<td></td>
<td>PBC4</td>
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<td>0.30</td>
<td>0.05</td>
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<tr>
<td>Attitude toward speeding (ATS)</td>
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<td></td>
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<td></td>
<td>ATT3</td>
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<tr>
<td>Speeding behavior intention (SBI)</td>
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<td>0.36</td>
<td>0.05</td>
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<tr>
<td></td>
<td>SBI2</td>
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<td>0.05</td>
<td>0.92</td>
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<tr>
<td></td>
<td>SBI3</td>
<td>0.94</td>
<td>0.11</td>
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<tr>
<td>Actual speeding behavior (ASB)</td>
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<td>0.00</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Goodness of fit indices

Comparative-fit index: χ² = 624.47, df = 189 (p < 0.001); χ²/df = 3.30, RMSEA = 0.09, GFI = 0.83. Normed fit index: CFI = 0.98, NFI = 0.97

* Contents of items refer to Table A1.
the average variance extracted (AVE) for each construct ranges from 0.51 to 0.91, which is over 0.5 and indicates that the scales have good convergent validities (Hair et al., 2006).

Discriminant validity is examined by comparing the square root of the AVE of each construct and its correlation coefficients with other constructs. As shown in Table 2, all square roots of AVEs are greater than the correlation coefficients of other constructs, thus indicating good discriminant validity.

### 3.2. Structural model

In total, five SEM models are estimated in this study, namely Model 1 (whole sample), Model 2 (low SS sample), Model 3 (high SS sample), Model 4 (novice sample), and Model 5 (experienced sample). A comparison between Models 2 and 3 is made to explore the moderating effect of sensation-seeking, while the moderating effect of riding experience with a heavy motorcycle is examined by comparing Models 4 and 5. Table 3 reports the estimated results of the models.

#### 3.2.1. Estimated results for the whole sample: Model 1

For Model 1, the structural model is estimated by using the whole sample data to examine the hypotheses. Fig. 2 shows the estimated model with standardized path coefficients. The fit measures indicate that the proposed model fits the data well: $\chi^2 = 596.61, df = 192 (p < 0.001), \chi^2/df = 3.11, RMSEA = 0.09, \text{CFI} = 0.84, \text{GFI} = 0.98, \text{NFI} = 0.97$.

Seven out of nine hypotheses in Model 1 are found to be supported. Speeding behavioral intention (SBI) is found to have a significantly positive effect on actual speeding behavior (ASB) (i.e. $\beta = 0.50, t = 7.65$), indicating the greater a motorcyclist’s positive attitude is toward speeding, the greater the likelihood that they intend to exceed the speed limit. However, the effects of both the subjective norm (SN) and perceived behavioral control (PBC) on speeding behavioral intentions are not significant. This finding is rather different from previous speeding studies based on the theory of planned behavior, in that the subjective norm and perceived behavioral control are always found to be the main factors affecting speeding behavioral intentions in these earlier works.

Regarding the psychological flow variables, the effects of perceived enjoyment (PE) ($\beta = 0.42, t = 5.38$) and concentration (CON) ($\beta = 0.27, t = 4.26$) on speeding behavioral intentions are, interestingly, found to be significantly positive. Additionally, both PE ($\beta = 0.50, t = 7.65$) and CON ($\beta = 0.33, t = 5.38$) have significantly positive effects on the attitude toward speeding. In other words, the psychological flow variables have not only direct effects, but also indirect effects through the mediation of attitudes toward speed-
ing on speeding behavioral intentions. For heavy motorcycle riders who tend to ride in order to enjoy the experience of speed, affective factors (i.e. perceived enjoyment and cognitive concentration) have more explanatory power with regard to their speeding behavioral intentions than do cognitive factors (i.e. the subjective norm and perceived behavioral control), and the same can be said with regard to the motorcyclists’ actual speeding behavior. These findings provide important insights that can aid our understanding of the speeding behavior of heavy motorcycle riders, which differs significantly from that of other riders and drivers.

### 3.2.2. Moderating effect of sensation-seeking: Models 2 and 3

To examine the moderating effect of sensation-seeking, the sample was divided into two groups based on the mean level of sensation-seeking (SS): high and low. The difference t-test indicates that there is a significant difference in the sensation-seeking level between the groups. The low-SS group contains 133 samples whereas the high-SS group contains 144. Columns 3 and 4 in Table 3 report the estimated results of the low-SS group (Model 2) and the high-SS group (Model 3), respectively. Overall, the results are consistent with those of the whole sample model (Model 1), except for two relationships, CON → SBI and ATS → SBI, showing the existence of a moderating effect of sensation-seeking upon heavy motorcycle riders’ speeding behavior.

The relationship CON → SBI is significantly positive ($\beta = 0.40$, $t = 4.14$) for the low-SS group, consistent with Model 1, while this relationship for the high-SS group appears to be insignificant. The relationship ATS → SBI is significantly positive ($\beta = 0.35$, $t = 3.78$) for the high-SS group and consistent with Model 1, while this relationship for the low-SS group appears to be insignificant. These findings have several interesting implications. First, for those motorcyclists with a low sensation-seeking level, their behavioral intentions toward speeding are directly and positively affected by affective variables (i.e. concentration and perceived enjoyment), while cognitive factors tend to inhibit their speeding intentions, even though affective variables have positive influences on their attitude toward speeding. On the other hand, for those respondents with a high level of sensation-seeking, the positive effects of affective variables enhance their attitudes in favor of speeding and in turn lead to a higher likelihood to speed. Therefore, it is important to identify heavy motorcycle riders’ sensation-seeking level to better understand their speeding behavior and tailor effective strategies to reduce the dangerous driving behavior of different groups.

### 3.2.3. Moderating effect of driving experience: Models 4 and 5

Driving experience has been viewed as a strong predictor to explain risky driving behavior in past studies (Liu et al., 2009; Underwood, 2007). To investigate the difference in driving experience with regard to speeding behavior, the respondents were divided into two driving experience groups: the novice group (less than three years’ experience, $N = 162$) and the experienced group (more than three years’ experience, $N = 115$). Columns 5 and 6 in Table 3 report the estimated results for the novice group (Model 4) and the experienced group (Model 5), respectively. Similar results to Model 1 are found, except for three relationships, namely SN → SBI, ATS → SBI, and CON → SBI.

These findings have several implications for drawing conclusions about the effects of experience on heavy motorcycle riders’ speeding behavior. First, the relationship SN → SBI for the experienced group is insignificant and consistent with Model 1, while it proves to be significantly negative ($\beta = -0.23$, $t = -2.66$) for the novice group. In other words, the subjective norm has a negative impact on the attitude toward speeding for novice motorcyclists rather than experienced ones. As the subjective norm refers to the perceived social pressure to perform or not to perform a certain form of behavior (Ajzen, 1991), if inexperienced motorcyclists perceive that the opinions of significant others who are close/important to them are against speeding, then their positive attitude toward speeding is likely to be reduced. However, once motorcyclists have more riding experience, they might look for the enjoyment of speeding more and not be influenced by the opinions of significant others. Second, the relationship ATS → SBI for the experienced group is significantly positive, but is insignificant for the novice group. Although affective factors tend to increase the favorable attitude toward speeding for both novice and experienced riders, unlike experienced motorcyclists, novice motorcyclists’ positive attitudes toward speeding do not seem to be strong enough to increase their intent to speed based upon a lack of past riding experience. Finally, the relationship CON → SBI ($\beta = 0.41$, $t = 4.05$) is significantly positive for the novice group, but is insignificant for the experienced group.

For novice motorcyclists, although the indirect effect of concentration mediated by the attitude toward speeding is found to be insignificant, it has a significant direct impact on intent to speed. Concentration is one important component of the psychological flow experience. For individuals to be in a “flow” state, they must first concentrate on their activities (Koufaris, 2002; Lu et al., 2009). Novice motorcyclists who focus their attention on riding seem to find it easier to enter the flow state and to become absorbed in their activities: their awareness is focused on the activity itself, they lose self-consciousness, and they feel they have control over their environment (Csikszentmihalyi, 1977). In this way, concentration results directly in a higher intention to speed for novice motorcyclists. For experienced motorcyclists, however, the effect of concentration on the intention to speed is evident only through the mediation of the rational process (i.e. attitude toward speeding) based upon their past experiences.

### 4. Discussion and conclusion

The main aim of this study is to integrate both the theory of planned behavior and the flow theory in order to explore the relationships between speeding behavior and its affecting factors among riders of heavy motorcycles in Taiwan. Furthermore, group differences in these motorcyclists’ speeding behavior are also examined in relation to sensation-seeking and riding experience considered as grouping variables.

Apart from the TPB variables, psychological flow variables are also integrated into the study model in order to take account of the intrinsic motivations behind the unique speed-seeking characteristics of these riders. Several findings deserve particular mention. First, the TPB variables (i.e. the subjective norm and perceived behavioral control) that have in previous studies usually been viewed as important antecedents of driver speeding behavior (Elliott, 2010; Elliott et al., 2003; Wong et al., 2010) are here found to be insignificant. On the other hand, the psychological flow variables (i.e. perceived enjoyment and concentration) appear to have significantly positive influences on motorcyclists’ speeding behavior. These findings imply that analyses that do not consider the contextual effect (e.g. a large-size heavy motorcycle environment) and behavior motives (speed-seeking) of motorcyclist speeding behavior might be seriously flawed. In other words, riders of heavy motorcycles, at least in Taiwan, belong to a special interest group who ride, by and large, for recreational purposes, and should thus be treated differently and differentiated from general motorcyclists who ride mainly for commuting purposes and have been examined in past studies (Chang and Yeh, 2007; Chen, 2009; Elliott, 2010; Wong et al., 2010). In particular, the effects of a motorcyclist’s psychological flow – neglected in past studies – should be addressed.
Second, personal factors such as personality traits and past experience have been found to reflect differences in motorcyclist speeding behavior in past studies (Chen, 2009), and this was confirmed in this study. Favorable attitudes toward speeding are enhanced by affective factors (i.e. concentration and perceived enjoyment) only for motorcyclists with a high level of sensation-seeking. The subjective norm plays a role for novice motorcyclists, having a significantly negative impact on their attitude toward speeding, but not for experienced ones. These findings therefore provide insights to better understand the speeding behavior of this special interest segment of motorcyclists, as well as useful information for designing road safety interventions and developing driver education and training programs. How best to make use of the affective factors (or intrinsic motivations) that relate to motorcyclist speeding behavior and apply them to practice will, however, undoubtedly prove challenging, and this suggests a direction for future research.

The present study, the first to attempt to integrate both TPB and flow theory to investigate the speeding behavior of riders of heavy motorcycles, demonstrates clear advances upon its predecessors in terms of both model construction and the expansion of behavior theory. However, although the results of this study contribute to the extensive and growing body of literature on speeding behavior, they do possess some limitations. For example, the survey data are limited, as only a sample of Taiwanese large-sized heavy motorcycle riders was used, and therefore direct applications of these findings to other countries should be used with caution since “each country has its own problems in traffic culture”, as noted by Özkan et al. (2006). Additionally, gender has been noted as an important factor in differentiating motorcyclist speeding behavior. As, currently, most heavy motorcyclists in Taiwan are male, group differences in speeding behavior with respect to gender are believed to be evident, but unfortunately are not investigated in this study due to data unavailability.

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Appendix A. Table A1

<table>
<thead>
<tr>
<th>Constructs/items</th>
<th>Scale of measurementa (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived enjoyment (PE)</td>
<td></td>
</tr>
<tr>
<td>PE1: I find riding heavy motorcycles to be enjoyable</td>
<td>20.6 16.2 23.8 16.6 22.7</td>
</tr>
<tr>
<td>PE2: I have fun riding a heavy motorcycle</td>
<td>21.7 18.4 20.6 18.4 20.9</td>
</tr>
<tr>
<td>PE3: The process of riding a heavy motorcycle is pleasant</td>
<td>20.9 18.4 20.9 17.7 22.0</td>
</tr>
<tr>
<td>Concentration (CON)</td>
<td></td>
</tr>
<tr>
<td>CON 1: Concentrate fully on speeding</td>
<td>13.7 8.3 10.1 24.5 43.3</td>
</tr>
<tr>
<td>CON 2: Absorbed intensely in speeding</td>
<td>14.8 10.1 13.7 24.2 37.2</td>
</tr>
<tr>
<td>CON 3: Deeply engrossed in speeding</td>
<td>12.6 5.8 7.6 27.1 46.0</td>
</tr>
<tr>
<td>CON4: Easily keep my mind on what is happening</td>
<td>13.4 8.3 12.6 25.6 40.1</td>
</tr>
<tr>
<td>Subjective norm (SN)</td>
<td></td>
</tr>
<tr>
<td>SN1: Most people who are important to me think that I should not speed when riding a heavy motorcycle</td>
<td>12.6 8.3 23.1 30.3 25.6</td>
</tr>
<tr>
<td>SN2: Most people who are important to me do not support me speeding when riding a heavy motorcycle</td>
<td>10.1 6.1 21.7 31.8 30.3</td>
</tr>
<tr>
<td>SN3: Most people who are important to me will not speed when riding a heavy motorcycle</td>
<td>15.2 20.2 28.5 17.7 18.4</td>
</tr>
<tr>
<td>Perceived behavioral control (PBC)</td>
<td></td>
</tr>
<tr>
<td>PBC1: When speeding, I believe my driving skills can meet the challenge</td>
<td>20.2 25.6 26.0 13.7 14.4</td>
</tr>
<tr>
<td>PBC2: When speeding, my capacity can match the high challenge of the situation</td>
<td>17.7 22.7 24.9 19.5 15.2</td>
</tr>
<tr>
<td>PBC3: When speeding, I feel in total control of what I am doing</td>
<td>16.2 19.9 23.8 21.3 18.8</td>
</tr>
<tr>
<td>PBC4: When speeding, I am capable of manipulating the vehicle without thinking how to do it</td>
<td>13.0 13.7 22.4 29.6 21.3</td>
</tr>
<tr>
<td>Attitude toward speeding (ATS)</td>
<td></td>
</tr>
<tr>
<td>ATT1: Beneficial</td>
<td>24.2 24.5 22.0 11.9 17.3</td>
</tr>
<tr>
<td>ATT2: Pleasant</td>
<td>13.0 13.0 15.2 32.5 26.4</td>
</tr>
<tr>
<td>ATT3: Good</td>
<td>14.4 13.7 23.5 23.1 25.3</td>
</tr>
<tr>
<td>ATT4: Acceptable</td>
<td>19.5 23.1 23.8 13.7 19.9</td>
</tr>
<tr>
<td>Speeding behavior intention (SBI)</td>
<td></td>
</tr>
<tr>
<td>SB1: Likely to speed</td>
<td>14.4 12.3 22.0 23.5 27.8</td>
</tr>
<tr>
<td>SB2: Intend to speed, if possible</td>
<td>17.7 13.0 20.6 23.8 24.9</td>
</tr>
<tr>
<td>SB3: Try to be speeding</td>
<td>17.7 12.6 20.2 21.7 27.8</td>
</tr>
<tr>
<td>Actual speeding behavior (ASB)</td>
<td></td>
</tr>
<tr>
<td>ASB1: How frequently did you exceed the speed limit in the last 6 months</td>
<td>31.8 11.9 10.5 5.1 40.8</td>
</tr>
</tbody>
</table>

*Except for the item ASB1, all other items are measured by a 5 point Likert-type scale ranging from 1 = “strongly disagree” to 5 = “strongly agree”. The ASB1 is measured by a five-rating scale ranging from 1 = “very infrequent (=1)” to 5 = “very frequent”.*
References


