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Validation of the Chinese-language Brief Sensation Seeking Scale: Implications for risky riding behaviors of parental motorcyclists and their child passengers

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ABSTRACT

Motorcycles are the leading cause of road traffic deaths in the Western Pacific and Southeast Asia, where Mandarin Chinese is the most commonly used language. Sensation seeking (SS) is reported to correlate with many risky motor vehicle behaviors, and therefore a culture-adapted Chinese instrument is needed to assess this personality trait in Chinese-speaking motorcycling populations. The standard front and blinded-backward process was carried out to formulate the Chinese-language Brief Sensation Seeking Scale (C-BSSS). 193 parental motorcyclists who rode with their young children were interviewed concerning their SS levels, demographics, riding behaviors, and the driving/riding experiences. A random sample of 30 subjects was re-interviewed 1–2 weeks later to examine the test-retest reliability. Psychometric analyses revealed satisfactory item characteristics, internal consistency, intraobserver reliability, and interobserver reliability. Additionally, parental motorcyclists who had the following characteristics were more likely to be the high sensation seekers (SSers), including male, younger age, presenting risky motor vehicle behaviors of themselves (e.g., higher riding speeds, operating after drinking, using a mobile phone while operating, and receiving a traffic ticket), and carrying child passengers who demonstrated dangerous motorcycling behaviors (e.g., a younger age, non-helmeted, and overloaded). We conclude that the C-BSSS is a useful and reliable measure of SS for ethnic Chinese populations. This instrument may be helpful to develop the future prevention strategy of motorcycle injuries in Chinese parental motorcyclists and their young child passengers.

1. Introduction

Nearly 1.3 million people die each year on the world's roads, and 60% of them were aged 15–44 years (WHO, 2013). Among all modes of road travel, motorcycling has been demonstrated to be the most dangerous (Beck et al., 2007; Hinds et al., 2007; Monk et al., 2009). In the US, motorcycle deaths and injuries have recently been rising and have become an important public health problem (Coben et al., 2007; Weiss et al., 2010a,b). In many Southeast Asian and Western Pacific countries, motorcycles are one of the major means of transportation and are also the leading cause of deaths in road travel (Lin et al., 2003a,b; Yu et al., 2011; WHO, 2013). In China, for example, 23,000 people died from motorcycling in 2010, accounting for 35% of all road traffic deaths (WHO, 2013). This problem may be more serious in Taiwan. On this 36,000-km^2 island, motorcycles accounted for two-thirds of registered motor vehicles in 2013, while they resulted in nearly half of all road traffic deaths (MTC, 2013).

Pediatric motorcycle injuries may be an important cause of children's deaths in Asia. As infectious diseases continue to decrease, injury is now a leading cause of death, permanent

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disability, and serious morbidity in children after infancy in many Asian countries (Linnan et al., 2007). Among all types of child injuries, motor vehicle crash is a major cause of fatalities (Linnan et al., 2007). In Taiwan, it is the first killer of children aged 1–19 years (MHW, 2011). Despite risky motorcycling behaviors by adolescents as reported in other countries (Pileggi et al., 2006), another possible explanation is connected to a phenomenon that parents in Taiwan commonly motorcycle with their young children.

Drivers' behaviors contribute to more than 90% of motor vehicle crashes (Evans, 1993). When it comes to young motorcyclists, risky behaviors appear to be dominant human factors rather than riding inexperience (Pileggi et al., 2006). There is a growing number of studies supporting a significant association of drivers' personality with their risky driving behaviors (Jonah, 1997; Jonah et al., 2001; Dahlen et al., 2005; Patil et al., 2006; Zakletskaia et al., 2009; Wong et al., 2010; Constantinou et al., 2011).

Among many personality traits, sensation seeking has received considerable attention. Zuckerman (2006) defined SS as "the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experience", while his Sensation Seeking Scale consists of 40 forced-choice items (Zuckerman et al., 1978). The Sensation Seeking Scale measure has been criticized for its length, colloquialisms and forced-choice response format (Hoyle et al., 2002; Stephenson et al., 2003, 2007). As a result, the Brief Sensation Seeking Scale (BSSS) was further developed as an alternative (Hoyle et al., 2002). The BSSS was shown to have satisfactory item characteristics and internal consistency across age, gender, and ethnic categories, and also had predictable associations with perceptions or experiences of smoking, drinking, and using illicit drugs (Hoyle et al., 2002; Stephenson et al., 2003, 2007).

As mentioned above, motorcycling is very popular in Southeast Asia and Western Pacific countries. Cross-cultural adaption of the BSSS is needed to assess this personality trait in Chinese-speaking motorcycling populations. Furthermore, not only adults but also children are suffering from motorcycle injuries in these ethnic Chinese populations. Since parents usually decide the riding style of their young child passengers, measuring the SS level of parental motorcyclists may be essential to identify high-risk groups for pediatric motorcycle injuries. Therefore, based on the theory of known-group validity (Cronbach and Meehl, 1955), 4 hypotheses were proposed when we developed and validated the C-BSSS:

1. Men are more likely to be high SSers than women;
2. Younger adults are more likely to be high SSers than older ones;
3. Parental motorcyclists with risky driving/riding behaviors are more likely to be high SSers than those without; and
4. Parental motorcyclists carrying child passengers with risky riding behaviors are more likely to be high SSers than those carrying child passengers without such behaviors.

2. Method

2.1. Participants

During the 5 Saturdays in June 2012, parents who rode motorcycles with their children were recruited in the motorcycle parking lot of the only one shopping mall in Changhua City, the capital of Changhua County and the second largest city in west-central Taiwan. Changhua City covers an area of 65.69 square kilometers with a population of about 236,000. There are approximately 38,600 (16.4%) children aged 14 years or below (DOHR, 2012). A parent was included if his/her age was 18 years or above and he/she rode a motorcycle with his/her own child who was aged 14 years or below at the time of the interview. Parents who rode motorcycles with more than 2 wheels (i.e., motor-tricycles or motorcycles with training wheels) or powered by other than gasoline (i.e., electric scooters) were excluded because of the different vehicle types.

2.2. Instrument

The BSSS retains the original conceptualization with four components of thrill and adventure seeking, experience seeking, disinhibition, and boredom susceptibility. The BSSS consists of 8 items (2 for each component), and each item uses a Likert scale of 1–5, with a larger score indicating higher SS. Following the convention in other studies of SS (Stephenson et al., 1999; D'silva et al., 2001; Jonah et al., 2001; Henderson et al., 2005; Evans et al., 2006; Zakletskaia et al., 2009), subjects with a BSSS score greater

Table 1
Demographics and the prevalence of risky behaviors of the study subjects.

Characteristic	Parental motorcyclist ($N = 193$)		Child passenger ($N = 193$)	
	No.	%	No.	%
Demographic				
Gender (Male)[c]	63	32.6	99	53.5
Age (years)[c]				
Mean ± SD	36.5 ± 5.7		6.6 ± 2.9	
Range	19.0–57.0		1.0–12.5	
Educational attainment				
Junior high school or below	14	7.3		
Senior high school	81	42		
College or above	98	50.8		
Risky driving/motorcycling				
Speeding (>70 km/h of local speed limit)[a]	5	2.6		
Crash experience[b]	46	23.8		
Operating within 1 h after drinking[b]	13	6.7		
Mobile phone use while operating[b]	41	21.2		
Received at least one traffic ticket[b]	54	28.0		
Non-helmeted[a,c]			77	40.1
Overloaded (≧3 persons on a motorcycle)[a,c]			91	47.4
Taking the position before the motorcyclist[a,c]			109	56.8

[a] The behavior occurred during the motorcycling journey just before our interview.
[b] Driving/motorcycling experience of all types of motor vehicles in the past 3 years.
[c] Several variables have few missing data, including 8 (4.1%) for child gender, 1 (0.5%) for parent age, and 1 (0.5%) for each risky riding behaviors of child passenger.

Table 2
Item descriptive statistics and internal consistency indicators for the Chinese-language Brief Sensation Seeking Scale.[a]

Item (by content domain)	Mean	SD	Median	r [b]	Cronbach's α if item deleted
Experience seeking					
1. I would like to explore strange places	2.9	1.0	3	0.37	0.74
5. I would like to take off on a trip with no preplanned routes or timetables	2.8	1.0	3	0.44	0.72
Boredom susceptibility					
2. I get restless when I spend too much time at home	2.6	1.0	2	0.30	0.75
6. I prefer friends who are excitingly unpredictable	2.2	0.8	2	0.52	0.71
Thrill and adventure seeking					
3. I like to do frightening things	1.9	0.7	2	0.59	0.71
7. I would like to try bungee jumping	2.1	1.1	2	0.53	0.70
Disinhibition					
4. I like wild parties	2.0	0.8	2	0.49	0.72
8. I would love to have new and exciting experiences, even if they are illegal	1.8	0.8	2	0.42	0.73
Total	18.4	4.4	18	–	0.75[c]

[a] Responses were given on a 5-point scale including: "strongly disagree", "disagree", "neither disagree nor agree", "agree", and "strongly agree" scored from 1 to 5, respectively. $N = 193$.
[b] Corrected item-total correlation.
[c] Cronbach's α of all items.

than or equal to the median were defined as high SSers, while those below the median were defined as low SSers.

The translation procedure of the BSSS complied with the adaption of Brislin's translation model (Jones et al., 2001). The procedure included three steps: a front and blinded-back translation, a pretest, and a focus group discussion which finally decided the Chinese translations whether relevant or not. The translation of each item was evaluated independently, and the three-step procedure would be repeated until all items were considered satisfactory. In the current study, 3 items passed at the first time of focus group discussion. The remaining 5 items went through the three-step procedure again, and then all passed at the second discussion. The two front and blinded-back translations were performed by an American expatriate at the first procedure and a telegraph reporter at the second. The two pretests were conducted among parents of students at two different elementary schools in Changhua County. The interviewees were asked to report if they could not understand or had any questions about the statements on the scale. As a result, there was no any report received in the present study, indicating the good face validity.

Table 3
The demographics, risky driving/motorcycling, and sensation seeking in parental motorcyclists.

Characteristic	Level of sensation seeking[a]		p	Effect size (Cramer's V)
	Low ($n = 73$, %)	High ($n = 120$, %)		
Demographic				
Gender				
Men	19.0	81.0	<0.001*	0.27*
Women	46.9	53.1		
Age (years)				
<30	35.0	65.0	0.032*	0.19*
30–40	31.7	68.3		
>40	53.1	46.9		
Risky driving/motorcycling				
Highest riding speed (km/hr)[b]				
<30	51.9	48.1	0.049*	0.18*
30–40	44.4	55.6		
>40	30.1	69.9		
Helmet type[b,d]				
Full-coverage	47.9	52.1	0.110	0.12
Half-coverage	35.0	65.0		
Crash experience[c]				
Yes	39.1	60.9	0.834	0.02
No	37.4	62.6		
Operating within 1 h after drinking[c]				
Yes	7.7	92.3	0.019*	0.17*
No	40.0	60.0		
Mobile phone use while operating[c]				
Yes	24.4	75.6	0.046*	0.14*
No	41.4	58.6		
Received at least one traffic ticket[c]				
Yes	25.9	74.1	0.034*	0.15*
No	42.4	57.6		

[a] A total BSSS score of <18 indicated a low level of SS, whereas of ≥18 indicated a high level of SS.
[b] The behavior occurred during the motorcycling journey just before our interview.
[c] Driving/motorcycling experience of all types of motor vehicles in the past 3 years.
[d] One motorcyclist who wore a helmet not for motorcycle use was excluded due to the small number.
* $p < 0.05$.

Table 4
The riding characteristics of child passengers[a] and the sensation seeking of the parental motorcyclists.

Characteristic	Level of sensation seeking[b]		p	Effect size (Cramer's V)
	Low (n = 73, %)	High (n = 120, %)		
Gender				
Boy	33.3	66.7	0.300	0.08
Girl	40.7	59.3		
Age (years)				
<5	25.8	74.2	0.018*	0.17*
≧5	43.5	56.5		
Position				
Before the motorcyclist	38.5	61.5	0.867	0.01
Behind the motorcyclist	37.3	62.7		
Helmet type				
Full-coverage	62.9	30.8	0.021*	0.20*
Half-coverage	40.2	59.8		
Non-helmeted	29.9	70.1		
No. of persons on the motorcycle				
Two	41.6	58.4	0.044*	0.18*
Three	39.0	61.0		
Four	7.1	92.9		

[a] If there were 2 or more child passengers on a motorcycle, one of them was randomly selected as a representative for the analysis.
[b] A total BSSS score of <18 indicated a low level of SS, whereas of ≧18 indicated a high level of SS.
* $p < 0.05$.

There were 9 bilingual subject matter experts in the focus group discussion, including a professor of public health, 2 pediatric physicians, 5 researchers who were familiar with the translation process, and 1 representative of the interviewees in the pretests. They paid attention to two aspects: whether the Chinese wording was fluent and understandable, and whether the meanings between the original BSSS and the blinded-back translation were equivalent. Each participant then designated the Chinese translation of each item as "relevant" or "not relevant", and it could not be passed unless the content validity index was >0.78 (i.e., 2 or fewer "not relevant" ratings among the 9 participants) as suggested by Lynn (1986). The content validity was then established by the strict voting process in the focus group discussion.

2.3. Procedure

Two trained interviewers recruited participants at the motorcycle parking lot by a structured questionnaire. In addition to the C-BSSS, information on demographics of the parental motorcyclists and child passengers (e.g., age, gender, and educational attainment), the highest speed of this riding journey, and the driving/motorcycling experience in the past 3 years (e.g., being involved in a motor vehicle crash as the operator, operating a motor vehicle within 1 h after drinking, using a mobile phone while operating a motor vehicle, and receiving a traffic ticket) were all collected.

At the same time, several riding behaviors of parental motorcyclists and child passengers were also observed at the scene, including helmet types (full-, half-coverage, and non-helmeted), position of child passengers (before or behind the motorcyclist), and total number of persons on the motorcycle. Full-coverage helmets were defined as those that covered the entire haired region of the head and both ears, whereas half-coverage ones were those that only covered the top part of the head but exposed both ears and the lower part of the occiput. In the current study, subjects who wore a nonstandard motorcycle helmet such as an industrial helmet, bicycle helmet, or in-line skating helmet were also categorized as being non-helmeted. Being non-helmeted is a known risk factor for motorcycle injuries and deaths (Liu et al., 2008), and half-coverage helmets have also been demonstrated to provide lower protectiveness than full-coverage ones (Yu et al., 2011). If a motorcycle seated 2 or more children, information on all child passengers was collected. However, only 1 child passenger, randomly selected by a random number table method, was analyzed to avoid the presence of dependent samples.

To examine the test-retest reliability, 2 assessments took place at 2 time points over a 1–2-week interval. A subsample of 30 subjects was randomly selected for the second assessment by telephone. In the second assessment, 15 subjects were interviewed by the same research assistants as at the first assessment to evaluate the intraobserver variation, while the other 15 subjects were interviewed by different research assistants to evaluate the interobserver variation. This research was approved by the Institutional Review Board of Show Chwan Memorial Hospital, one of the major hospitals in Changhua City. Informed written consent was obtained from each participant.

2.4. Statistical analysis

The internal consistency was evaluated by the methods of Cronbach's α, corrected item-total correlations, and Cronbach's α if item deleted. Both intraobserver and interobserver reliabilities were evaluated by the intraclass correlation coefficient (Shrout and Fleiss, 1979). The validation based on the concept of known-groups validity was proceeded by examining the relationships between the level of SS and the various riding characteristics of the parental motorcyclists and child passengers, in which a Chi-squared or Fisher's exact test was used for the statistical analysis, and a Cramer's V was used to evaluate the effect size. A p value of <0.05 indicated statistical significance. All statistical analyses were conducted using IBM SPSS version 19 (SPSS, Chicago, IL, USA).

3. Results

3.1. Demographics and the prevalence of risky riding behaviors

In total, 193 parental motorcyclists along with 264 child passengers completed the interviews, and only 193 child passengers were analyzed after the random selection procedure described above. The demographics and the prevalence of risky behaviors are listed in Table 1.

3.2. Item descriptive statistics and the reliability

Table 2 presentsdescriptive statistics and internal consistency measures of the C-BSSS. The mean item scores of the C-BSSS mostly fell within 2–3 points, indicating no ceiling or floor effect in the responses. Standard deviations of these item scores were generally stable. The median of the total score was 18, and therefore there were 73 low SSers and 120 high SSers. Cronbach's α of the entire scale was satisfactory at 0.75 (Bland and Altman, 1997; Lance et al., 2006; Portney and Watkins, 2008). Values of the corrected item-total correlations were all >0.3, suggesting that each item correlated well with the others (Ferketich, 1991). All values of Cronbach's α of any 7-item combination (Cronbach's α if item deleted method) were no greater than Cronbach's α of the entire scale, indicating that no item should be deleted. Among the subsample of 30 subjects for the test-retest reliability measurement, the distributions of age and gender (mean age of 36.8 ± 7.2 years, and 30% men) were similar to the total sample. The intraclass correlation coefficient was good at 0.67 (95% confidence interval, 0.28–0.88) for the intraobserver reliability and excellent at 0.81 (95% confidence interval, 0.46–0.94) for the interobserver reliability (Cicchetti and Sparrow, 1981).

3.3. The known-groups validity of the parental motorcyclist

Table 3 summarizes the riding characteristics of parental motorcyclists for high and low SSers to examine the hypothesis 1–3. The proportion of high SSers was significantly greater in men than women, and also greater in the younger groups (<30 and 30–40 years) than the older group (>40 years). Furthermore, the highest speed in this riding journey showed a dose-dependent response; that is, the faster they rode, the more likely they were high SSers. The overall rate of helmet use among parental motorcyclists was very high at 99.5%, including 25% full-coverage and 74.5% half-coverage helmets. However, subjects who wore half-coverage helmets (lower protectiveness) might more likely to be high SSers than those who wore full-coverage ones. In addition to the type of helmet, motorcyclists with various risky driving/motorcycling experiences significantly tended to be high SSers than those without. These risky behaviors were alcohol-impaired driving/motorcycling, distracted driving/motorcycling (using a mobile phone while operating), and the presence of traffic violation records. Nevertheless, no matter the motorcyclist had crash experience or not, the likelihood of being a high SSer was similar.

3.4. The known-groups validity of the child passenger

Table 4 liststhe hypothesis 4 test results by demonstrating the relationship between the SS level of parental motorcyclists and the riding characteristics of child passengers. The proportions of high SSers had a significant difference in child passengers' age groups, but not in their genders. In other words, high SSers were more likely to motorcycle with young children than low SSers. Moreover, the helmet types and overloaded status both demonstrated a strong dose-dependent effect. It showed that the more dangerous riding behaviors that child passengers presented, the more likely the parental motorcyclists were high SSers. However, the position of the child passengers showed no significant relationship with the SS level of parental motorcyclists. The effect size shown in Tables 3 and 4 were mostly significant and between 0.1 and 0.3, suggesting the small to medium associations between the SS level and these riding characteristics.

4. Discussion

Our results suggest that the C-BSSS is a reliable and valid tool to evaluate the personality trait of SS in parental motorcyclists. Moreover, as far as we know, the present study is the first research to demonstrate that risky riding behaviors of child passengers may be connected to the SS level of parental motorcyclists. This finding should be beneficial for developing effective prevention strategies for pediatric motor vehicle injuries.

The mean item score of the BSSS mostly ranged 3–4 points in an American population (Hoyle et al., 2002; Stephenson et al., 2003), in contrast to 2–3 points in our participants. One possible reason is cultural and language differences. Stephenson et al. (2007) reported that there was a significant difference in the mean item scores of the BSSS between English and Spanish speakers in the same population. Another possible reason is differences in demographic characteristics across study samples. Unlike most previous studies in which study subjects were sampled from adolescents (Hoyle et al., 2002; Stephenson et al., 2003), our subjects were mainly middle-aged adults who were already parents, and this population is less likely than adolescents to engage in risky behaviors. In spite of the relatively low risk-taking population, the C-BSSS still worked satisfactorily.

While most previous studies only examined the internal consistency of the BSSS (Hoyle et al., 2002; Chen et al., 2013), little is known about its temporal stability (Chen et al., 2013). Not only did our results support the excellent internal consistency of the BSSS, but also complemented its very good test-retest reliability. In addition, the C-BSSS may have adequate known-groups validity. Consistent with previous studies (Hoyle et al., 2002; Stephenson et al., 2003; Constantinou et al., 2011; Chen et al., 2013), men had higher levels of SS than women. Our results also showed that younger adults had higher SS than older adults, but Stephenson et al. (2003) reported that younger teens had lower SS than older teens. We preferred to interpret this as a complementary finding, because of age differences among study samples. Since the SS level could be highest in youth and relatively lower in extreme age groups (i.e., young adolescents and the elderly), longitudinal studies are needed to clarify the potential effect of age differences on SS.

A considerable amount of research has demonstrated positive correlations between SS and many risky driving or motorcycling behaviors (Jonah et al., 2001; Dahlen et al., 2005; Patil et al., 2006; Zakletskaia et al., 2009; Wong et al., 2010; Constantinou et al., 2011). Our results show that motorcyclists with risky riding behaviors are more likely to be high SSers, supporting the construct validity of the C-BSSS. However, SS did not seem to have relevance to motor vehicle crashes in our study. Does this result threaten the validity of the scale? The answer would likely be no! In fact, a lot of studies have been done on this issue, and the results appear to contradict one another (Elander et al., 1993; West et al., 1993; Jonah, 1997; Lawton and Parker, 1998; Sumer, 2003; Dunlop and Romer, 2010). Jonah (1997) performed a comprehensive review of 40 articles, in which 7 of 12 studies exhibited significant differences in crash involvement between high and low SSers, while the other 5 studies did not. Recently, a study of nationwide youth samples in the US pointed out no direct relationship between SS and crashes in their structural equation models (Dunlop and Romer, 2010). Further research with a more rigorous design is required to address this issue.

Another interesting finding in our study is that the more dangerous level of riding behaviors child passengers presented, the more likely the parental motorcyclists to be high SSers. As we know, many risky behaviors of young child passengers such as the helmet type, the position, the total number of persons, and the minimum age were mostly determined by parental motorcyclists.

Therefore, it is reasonable that high SSers would expose not only themselves but also their child passengers to risks of injury during motorcycling. However, the position of the child passengers had no relationship with the SS level of the parental motorcyclists. One possible explanation is that the injury risk from the position for motorcycling child passengers remains unclear. Although the front seat for children under 4 years was reported to have twice the risk of death and a 60% higher risk of serious injuries in car crashes, compared to the rear seat (Lennon et al., 2008), there are still limited data to illustrate whether the position on a motorcycle is an independent risk factor for pediatric motorcycle injuries. Another possible explanation is that many parents believe the front position is safer for their young children, because the children are within their arms' reach instead of being behind their backs, especially when the muscle strength of children is too weak to hang onto the motorcycle in an acceleration or deceleration situation.

Several limitations of the present study need to be addressed. First, since all of the participants were recruited at a shopping mall on a volunteer basis, they cannot be considered to be representative of the motorcycling population in Taiwan. Therefore, the external validity of our results may be somewhat limited. Moreover, the lack of validation by other health risk behaviors such as alcohol consumption, cigarette smoking, or substance abuse may also limit the utility of this instrument. Finally, because SS by the children was not measured, we could not determine whether the relationship between the riding behaviors of the child passengers and SS of the parental motorcyclists was confounded by the SS of the child passengers themselves. In fact, there may be no appropriate instrument for assessing SS by children in the current study. Morrongiello and Lasenby (2006) developed a 40-item sensation seeking scale for children; however, the scale may be too lengthy to interview children in a parking lot. Moreover, this scale was designed for children aged 7–12 years; however, more than half (56.5%) of the children were under 7 years old in this study.

In conclusion, the Chinese-language Brief Sensation Seeking Scale exhibits very good psychometric properties, and provides a reliable measure of sensation seeking in ethnic Chinese populations. This instrument may be useful to identify the high risk groups of risky riding behaviors, and therefore may be helpful to develop the future prevention strategy of the motorcycle injuries in Chinese parental motorcyclists and their young child passengers.

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