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# **PSYCHOLOGICAL ASPECTS OF THE RISK OF ACCIDENTS FOR MOTORCYCLISTS**

## ABSTRACT

Per 100,000 registered motorcycles, 14 motorcycle riders were injured or killed in a traffic accident in Germany in 2013. Motorcyclists are most at risk to be killed by an accident according to the official national accident statistics. Young motorcycle riders (15 - 25 years) are over-represented in the accident statistics, measured in terms of population. The 55 - 65 age group has the highest risk of being killed in a motorcycle accident. Moreover, the absolute number of injured or killed motorcyclists at the age of 65 or above has increased about 160% since the year 2000.

The focus of the present study was to gain more detailed information about the German motorcycling population and to investigate psychological aspects associated with the accident risk of this group. Furthermore, the target of the study was to identify high risk subgroups in order to develop safety measures that specially address these groups.

For this purpose, a representative survey among over 1,000 German motorcyclists was conducted in 2012.

Reported accident prevalence (10% of the entire group) was highest for the 18 - 24 age group (17%). Results show differences between accident involved and non involved motorcyclists with respect to e.g. age and frequency of motorcycle use. A cluster analysis based on personality traits revealed five subgroups within the whole sample. One of these clusters has by far the highest accident risk: for this personality type (characterised by young persons scoring high on excitement seeking, hostility and normlessness, and low on altruism) the accident involvement rate is 23%. The group exhibits risky attitudes to motorcycling and hazardous driving behaviour. Recommendations for traffic safety measures are drawn from the results.

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## INTRODUCTION

According to the national German accident statistics motorcyclists are most at risk of being seriously injured or killed in a road traffic accident compared to other groups of road traffic users (Statistisches Bundesamt, 2014a). The absolute number of injured motorcyclists with over 27,000 people is comparably low in comparison to 377,481 casualties in German road traffic. But looking at the absolute numbers of accident involved road traffic users alone doesn't allow drawing an accident risk rate for the specific group. The accident risk depends on the exposure of the specific road traffic user group therefore the absolute number of casualties is regarded for example in relation to the number of registered vehicles or the yearly distance travelled. In relation to the number of registered motorcycles the fatality risk for motorcycle users is very high. Per 100,000 registered motorcycles 14 riders were killed in 2013 while it was 4 fatalities per 100,000 registered cars.

In addition there are large differences for the risk of being injured in a motorcycle crash by age. On the one hand, the younger the motorcyclists are the higher the number of injured is in relation to the number of inhabitants in this group. Per 100,000 inhabitants 134 adolescents between 15 and 18 years were injured by a motorcycle accident in 2013. For people at an age of 65 years or above it is only 8 injured. On the other hand, the absolute number of injured motorcyclists has dramatically increased for elderly since 2000 (see figure 1). For motorcyclists aged 65 years or older the number of injured has risen by about 160 % while there was a decrease for younger age groups. Because exposure data separated to age groups is not available it is not possible to assess the risk rate by age.

Although motorcyclists are often endangered by other motorized traffic users who e.g. fail to see them, the motorcyclist's own behaviour was rated by the police to have caused the accident in almost half of the cases (Statistisches Bundesamt, 2014a). The most frequent reported misbehaviour of accident-involved motorcyclists was inappropriate speed followed by too short distances and failures while overtaking (see figure 2).

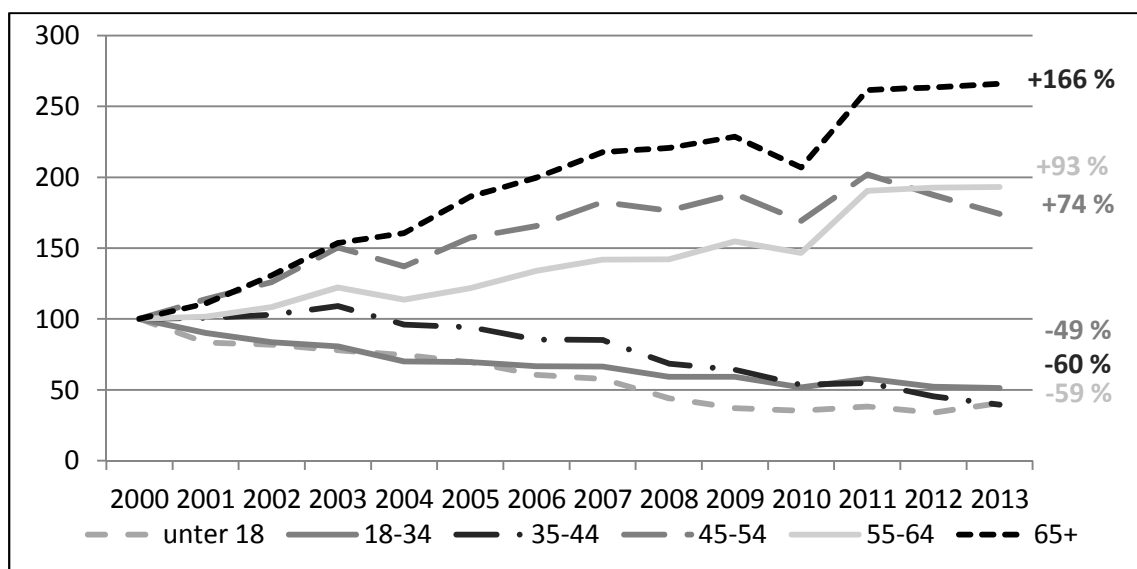


Figure 1: Trend of the number of injured (slightly, seriously and fatally) motorcyclists by age group in percent from 2000 (100%) to 2013 (data source: Statistisches Bundesamt, 2014a).

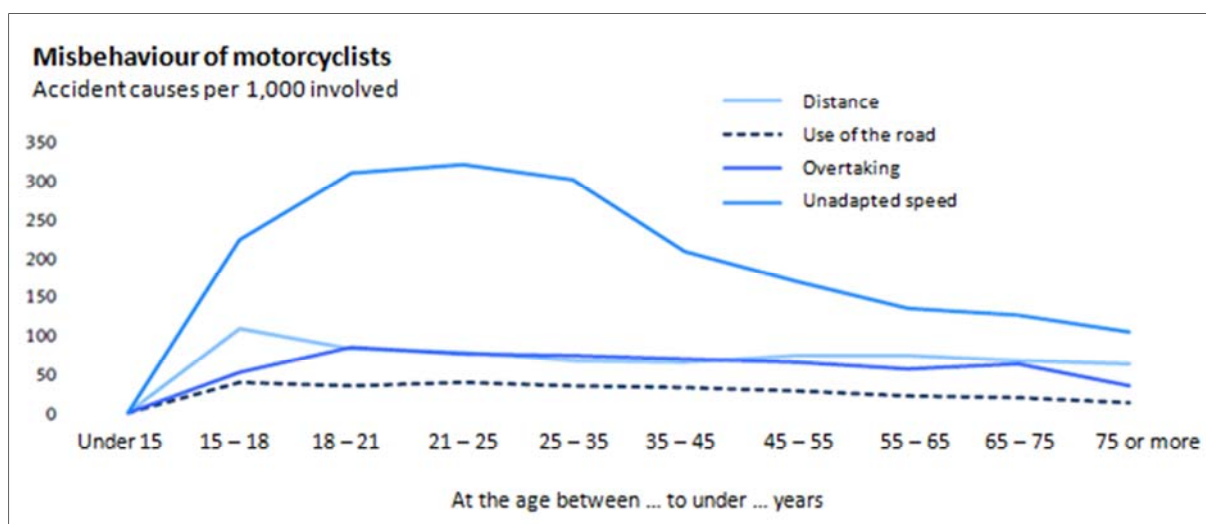


Figure 2: Accident causes per 1,000 involved motorcyclists by age group (Statistisches Bundesamt, 2014b).

However, not all motorcyclists are at the same high risk of getting involved in an accident. This heterogeneity of the road user group at hand can be either due to different motives of motorcycle use or due to different levels of risk-taking. Personality characteristics contribute to risk-taking behaviour in traffic. Several studies have shown the influence of some personality traits on the road safety of motorized vehicle users.

Elander et al. (1993) provided an overview of studies that have found a small but direct influence of personality traits on accident involvement of car drivers. Furthermore a statistical relation between particular personality traits and accident involvement was found in several studies (e.g. Bachoo et al., 2013; Hilvaki et al., 1989; Jonah, 1997; Ulleberg, 2002; West & Hall, 1997).

One personality trait that was often used within research projects is sensation seeking. It describes one's need for new and exciting experiences. Mannering and Grodsky (1994) state that one of the main reasons for motorcyclists' high accident risk is that especially those people willing to take risks are in favour of using a motorcycle. Sensation seeking was found to be a good predictor of safety relevant behaviours in the studies of, e.g., Herzberg and Schlag (2003); Iversen and Rundmo (2002); Schulze (1999); Watson et al. (2007); Wong et al. (2010).

Other personality traits and their influence on traffic safety were investigated only in few studies. Altruism, for example, was found to determine the attitude towards traffic safety relevant aspects and safer traffic behaviour of car drivers (Machin & Sankey, 2008; Ulleberg, 2002). Furthermore, anxiety was related to risk awareness and attitudes and weakly related to risky traffic behaviour (Ulleberg, 2002). Ulleberg also tested direct and indirect effects of normlessness (a construct designed by Kohn & Schooler, 1983) and hostility on attitudes and driving behaviour of car drivers within a structural equation model. The model showed a small negative direct effect for hostility on attitudes and a small positive indirect effect on traffic behaviour meaning that hostility is a bad predictor for both criteria. Furthermore the model showed that normlessness was the best (indirect) predictor among the personality traits for attitudes and risky behaviour. People with high scores on normlessness showed a risky attitude and risky traffic behaviour.

In some studies personality traits are used to build subgroups within certain road user groups. These more homogeneous subgroups would then allow the development of safety measures that are directly targeting these groups and therefore are promising to be more effective than measures targeting the whole group (Holte & Pfafferoth, 2014).

Donovan et al. (1988) identified three clusters within a group of high-risk drivers that differ in the underlying personality structure. The first cluster showed high levels of impulsiveness, assaultiveness, sensation seeking and hostility. The second cluster was characterised by high hostility, depression and low emotional adjustment. The third cluster was described as being well adjusted with values around average for all personality traits. Deery and Fildes (1999) found five clusters for a group of young novice drivers of which two could be classified as high-risk driver types. Both groups showed high values for sensation seeking, hostility, assaultiveness and driving related aggression. In addition for one group high levels of depression and irritability were found. For a group of young drivers Ulleberg (2002) could identify six subgroups. Two of these groups were classified as high-risk groups. One high-risk group showed high levels of normlessness, sensation seeking and driving anger and low levels of altruism and anxiety. The other high-risk group was characterised by high levels of aggression, anxiety, driving anger and sensation seeking and low levels of altruism.

Brandau et al. (2011) performed a cluster analysis for a group of adolescent (14-17 years) moped riders on the base of a variety of personality concepts. Based on the results of the analysis the authors decided that a four cluster solution fits best. The groups did not differ in regards to gender, type of school and distance travelled by moped. Two of these clusters

reported a high rate of injuries caused by moped crashes. One of these groups showed high scores for novelty seeking, risk taking, reward dependence, inattention, and impulsivity and low scores on conscientiousness, agreeableness, and openness. The other group had a high level of neuroticism, and low levels of extraversion and openness.

Though based on different methodologies and personality constructs in all studies the detected subtypes differed in safety relevant characteristics like traffic behaviour and accident involvement. Ulleberg (2002) also found differences in the responses to a traffic safety campaign between these groups: Low-risk groups responded more positive to this campaign and stated to be more concerned by the topic than the high-risk groups.

The present study provides a detailed description of the German motorcycle rider population. Furthermore, the aim of the study was to identify subgroups of motorcyclists based on their personality characteristic in order to get more information about rider groups high at risk for accidents. As the literature review above shows, such studies have been conducted for other road user groups, and have proven to be successful. Such an approach could help to design targeted educational efforts and/or safety campaigns.

## METHOD

### SAMPLE

A face-to-face interview survey was carried out by an opinion and market research institute in Germany. In order to gain a representative sample of German motorcyclists a two-stage procedure was designed. In a first step a short questionnaire was included in an omnibus telephone survey with a sample of over 10,000 people representative for German inhabitants aged 16 and above. The sample contained 1,000 people owning a motorcycle driving licence (European driving licence A1, A2 or A) and having a motorcycle with an engine size of equal or above 50ccm at their disposal. In the second step the structure of sociodemographic variables found in the telephone survey was used as the basis for the quotation plan of the interview survey. 1,039 motorcyclists were interviewed between December 2011 and January 2012. The sample results were weighted and therefore are representative for German motorcyclists with regard to gender, age, educational level, federal state, size of town and the engine size of the most frequently used motorcycle.

### MEASURES

The questionnaire included a number of traffic related variables like type of most frequently used motorcycle, frequency of motorcycle use, yearly travel distance in kilometres,

motorcycle accident involvement within the past three years and entries in the German Central Traffic Register (VZR) for traffic offences while riding a motorcycle.

Motorcycle riding behaviour was assessed by 33 dichotomous items. These items were derived from the Driver Behaviour Questionnaire (DBQ) by Reason et al. (1990), the Motorcycle Riding Behaviour Questionnaire (MRBQ; Elliot et al., 2007) and self-developed items were added. The English statements of DBQ and MRBQ were translated into German. A factor analysis with 28 of the 33 items revealed a four factor structure (*riding errors, competition, quickly getting ahead, braking rules*). 11 items loaded on the factor *riding errors* e.g. “not seeing an obstacle and having difficulty stopping in time“, “trying to overtake another vehicle without realizing that it is flashing left“, “Almost losing control while driving in a curve“. The second factor *competition* was build out of six items for example “driving too fast to show others you can deal with the bike“, “running a race with other riders“, “driving recklessly or performing dangerous stunts to test your own skills“. The third factor was called *quickly getting ahead*. The items loading high on this factor were “passing between two tracks in the fast-moving traffic“, “often changing lanes to move ahead faster in traffic“, “passing between two tracks in standing traffic“. With five items *braking traffic rules* forms the fourth factor of risky riding behaviour in the current study. Examples of items are “running over a stop or give way sign“, “driving, if you could have or exceed the legal blood alcohol level“, “driving after taking marijuana or any other illicit drug“.

The following three scales of attitudes that were adopted from Schulze (1999) and Holte (2012) were included in the questionnaire. First, the attitude towards high speed was measured by 22 statements that could be approved or disapproved to on a four-point-scale. After eliminating five items the remaining loaded on one factor of attitudes towards high speed. Second, five items measuring the attitude towards drink driving resulted in one factor. The same four-point-scale was used. Third, the attitude towards aggressive riding behaviour was assessed with ten items on a ten-point-scale. A factor analysis resulted in one factor for all ten items.

Personality was assessed equivalent to Ulleberg (2002). Anxiety, hostility, altruism and excitement seeking were drawn from the German version of NEO-PI-R (Ostendorf & Angleitner, 2003). The four-item normlessness-scale (Kohn & Schooler, 1983) was translated to German. Items were rated on a five-point Likert-scale.

Five items were designed to measure the self-identification of the respondents as a typical motorcyclist. These five items could be approved or disapproved to on the same four-point scale mentioned above.

Due to the limited length available in the paper at hand only a short description of the performed factor analyses can be reported here. A detailed description of these can be found in the published project report (von Below & Holte, 2014). All factors were calculated by summing up the individual item scores. Mean scores (standard deviation), minimum, maximum, number of items and reliability scores (Cronbach's Alpha) for each factor are shown in table 1.

Table 1. Mean scores (standard deviation), minimum and maximum, number of items and reliability coefficients (Cronbach's Alpha) of all factors.

	Mean (SD)	Min	Max	Number of items	Cronbach's Alpha
<b>Attitude to speeding</b>	21.5 (10.14)	0	51.0	17	.92
<b>Attitude to drink driving</b>	2.9 (3.38)	0	16.8	6	.83
<b>Attitude to aggressive riding behaviour</b>	20.6 (17.12)	0	84.0	10	.89
<b>Riding errors</b>	1.0 (1.76)	0	11.0	11	.94
<b>Competition</b>	0.9 (1.39)	0	6.0	6	.91
<b>Quickly getting ahead</b>	1.6 (1.50)	0	5.0	5	.87
<b>Braking traffic rules</b>	2.7 (0.97)	0	6.0	6	.88
<b>Self identification</b>	7.5 (4.12)	0	15.0	5	.89
<b>Anxiety</b>	11.3 (5.53)	0	32.0	8	.77
<b>Hostility</b>	10.9 (5.37)	0	30.0	8	.73
<b>Altruism</b>	23.2 (5.46)	0	32.0	8	.83
<b>Excitement seeking</b>	15.6 (6.59)	0	31.0	8	.78
<b>Normlessness</b>	7.2 (3.29)	0	16.0	4	.62

## STATISTICAL ANALYSES

Data was analysed by use of SPSS19 for Windows. Descriptive analyses were run to show sociodemographic characteristics of the sample and the distribution of several traffic related variables. The clustering of the sample was obtained by a hierarchical cluster analysis and enhanced by calculating a cluster centre analysis. The goodness of fit of the resulting cluster solution was checked with a discriminant analysis. Between group comparisons for traffic safety related issues were executed using ANOVA or Chi<sup>2</sup>-tests depending on the scale level of variables.

## RESULTS

### DESCRIPTIVE RESULTS

In the representative sample of 1,039 motorcyclists 15% are female and 85% male. The mean age is 43.7 years (SD = 13.15) with the highest proportion between the age of 45 to 54 years (29.6%).

The type of the motorcycle the interviewees most frequently use is broadly distributed. The highest share has the touring style motorcycle which is used by almost one fifth of the group, followed by chopper style motorcycles. Over 30% of respondents use a motorcycle with an engine size of 750 ccm or bigger. A higher proportion of women compared to men use motorcycles with smaller engine sizes between 250 and 750 ccm. With age the proportion of users of motorcycles with bigger engine sizes raise up to 40% in the age between 45 and 64 years.

On average all motorcyclists hold their driving licence for 23 years ( $SD = 12.78$ ). Only few respondents (2%) do not hold a driving licence for a car in addition. The motorcycle is used for trips several times a week or several times a month by the majority of respondents. Only one out of ten motorcyclists use their motorcycle daily for commuting purposes or equal. The mean distance that was driven by motorcycle per year is 5,163 kilometres ( $SD = 4,199.34$ ). Within the previous three years about 10% of the sample has been involved in at least one motorcycle accident. Between the age groups there are significant differences in the accident rate. The highest accident rate was found for young adults between 18 and 24 years (16.9%). As figure 3 shows those people reporting an accident involvement while driving a car are more likely to have also been involved in a motorcycle accident (13.8%) than riders that do not report a car accident (8.7%) ( $\chi^2 = 5$ ;  $p = .029$ ; Cramer-V = .068). With the frequency of motorcycle use the rate of accident involved riders rises significantly ( $\chi^2 = 20$ ;  $p = .000$ ; Cramer-V = .139) (see figure 4). As it was expected those motorcyclists who are using the motorcycle daily are more often involved in accidents than those using it less frequently. Their accident involvement (18%) is three-times higher than of those using the motorcycle only monthly or less (6% resp. 7%).

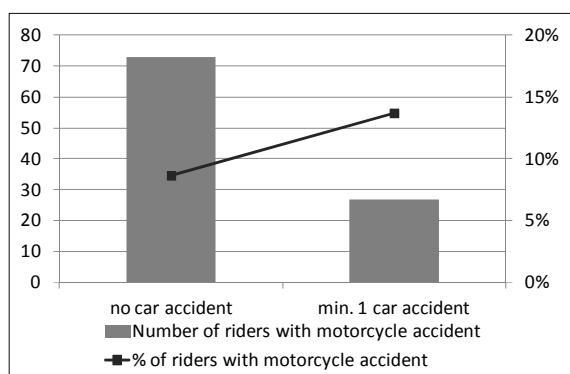


Figure 3: Absolute number and proportion of riders with accident involvement by involvement in car accident.

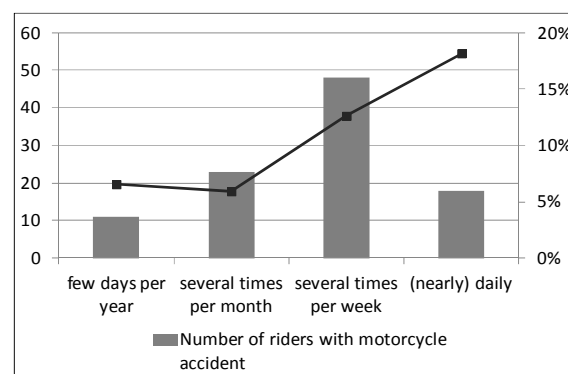


Figure 4: Absolute number and proportion of riders with accident involvement by frequency of motorcycle use.

## CLUSTER ANALYSIS

A cluster analysis was done to build homogeneous subgroups. The analysis was based on five personality traits – anxiety, hostility, altruism, excitement seeking and normlessness – and a new scale which reflects the self-identification of respondents as a typical motorcyclist and being part of the motorcycle group. Table 2 presents the correlation coefficients, mean scores and standard deviations for the variables. It shows that the personality traits are low to moderately correlated to each other. The results of the cluster analysis reveal five personality types within the motorcycle group. Table 3 shows the characteristics of these five types regarding to the used scales.

Table 2. Correlation coefficients, mean scores and standard deviations of personality variables.

	1	2	3	4	5	Mean	SD
<b>1</b> Excitement seeking	-					15.6	6.6
<b>2</b> Altruism	.56**	-				23.1	5.5
<b>3</b> Anxiety	-.21**	-.49**	-			11.3	5.5
<b>4</b> Hostility	-.00	.23**	-.16**	-		10.9	5.4
<b>5</b> Normlessness	-.02	.28**	-.27**	.43**	-	7.2	3.3
<b>6</b> Self-identification	-.22**	.01	.04	.38**	.24**	7.5	4.1

**TYPE 1:** Type 1 includes 13% of the motorcycle sample. Those respondents belonging to Type 1 can be characterised by low anxiety and hostility and high altruism. Furthermore, those motorcyclists seek above-average for new and exciting experiences. The self-identification with the group of motorcyclists is comparably high in this type.

**TYPE 2:** The motorcyclists of Type 2, which contains one fifth of the whole group, have low values for hostility, excitement seeking, normlessness and anxiety. Moreover, Type 2-motorcyclists are highly altruistic meaning that these respondents care for the welfare of others. They do not see themselves as a typical motorcyclist.

**TYPE 3:** 16% of the sample are categorised as Type 3-motorcyclists. Those motorcyclists belonging to Type 3 exceed high scores for hostility, normlessness and excitement seeking and low scores for altruism. Furthermore, these people see themselves as a typical motorcyclist and as part of the motorcycle community.

**TYPE 4:** Type 4 includes 22% of the sample. Typical for these respondents are high values of anxiety and hostility combined with a low level of altruism. Additionally the value on the self-identification scale as a typical motorcyclist is low in this group.

**TYPE 5:** One quarter of the motorcycle groups is identified as Type5-motorcyclist. Noticeable, for these motorcyclists is that all personality traits have scores around average except for the normlessness scale. The latter is slightly higher than average meaning that Type 5-motorcyclists tend to ignore existing social norms or rules.

Table 3. Profiles of the five personality clusters (Type 1 to 5).

	TYPE 1	TYPE 2	TYPE 3	TYPE 4	TYPE 5
<b>Excitement seeking</b>	+	-	+	/	/
<b>Altruism</b>	+	+	-	-	/
<b>Anxiety</b>	-	-	/	+	/
<b>Hostility</b>	-	-	+	+	/
<b>Normlessness</b>	/	-	+	/	+
<b>Self-identification</b>	+	-	+	-	/

Legend: + = mean score above average - = below average / = around average

## GROUP COMPARISONS

Besides the heterogeneity of the five subgroups with regard to personality traits the types substantially differ with regard to several, in part safety relevant criteria (Table 3). First of all there are significant age differences between the five personality types (ANOVA:  $F = 12$ ;  $df = 4$ ;  $p = .000$ ;  $\text{Eta}^2 = .05$ ). The motorcyclists belonging to Type 3 are the youngest group with an average age of 38 years ( $SD = 11.88$ ). Type 2 has the highest mean age with more than 47 years ( $SD = 12.56$ ).

More important than the age variation of the subgroups, is the fact that by clustering the motorcycle sample on the base of personality traits it is possible to identify subgroups that are high at risk in traffic. There are considerable differences in the accident involvement rate between the groups ( $\text{Chi}^2 = 48$ ;  $p = .000$ ;  $\text{Cramer-V} = .22$ ). Results show that Type 3 the youngest group with high values in excitement seeking, hostility and normlessness and a low score for altruism has the highest proportion of people being involved in a motorcycle accident within the past three years (23 %). Additionally this group has the highest rate of motorcyclists with an entry in VZR for traffic offences while riding ( $\text{Chi}^2 = 53$ ;  $p = .000$ ;  $\text{Cramer-V} = .13$ ). Furthermore, Type 3-motorcyclists exhibit the most risky attitude towards speeding (ANOVA:  $F = 86$ ;  $df = 4$ ;  $p = .000$ ;  $\text{Eta}^2 = .26$ ), drink driving (ANOVA:  $F = 73$ ;  $df = 4$ ;  $p = .000$ ;  $\text{Eta}^2 = .23$ ) and aggressive riding behaviour (ANOVA:  $F = 75$ ;  $df = 4$ ;  $p = .000$ ;  $\text{Eta}^2 = .23$ ) and exceed the highest scores on three out of four risky riding behaviour factors. The average yearly travel distance of this group is above the average (ANOVA:  $F = 32$ ;  $df = 4$ ;  $p = .000$ ;  $\text{Eta}^2 = .12$ ).

Table 3. Cluster differences on age, accident involvement, traffic offences, yearly travel distance in kilometres, attitudes and riding behaviour. Mean scores and standard deviations in brackets resp. proportion in percent.

	TYPE 1	TYPE 2	TYPE 3	TYPE 4	TYPE 5
<b>Mean age</b>	42.1 (12.82)	47.2 (12.56)	38.3 (11.88)	43.8 (12.31)	43.9 (12.87)
<b>Accident involvement</b>	9 %	9 %	23 %	9 %	4 %
<b>Traffic offences</b>	13 %	5 %	22 %	7 %	8 %
<b>Yearly distance in km</b>	7,595 (4,824)	4,263 (3,049)	6,535 (4,476)	3,822 (4,047)	4,026 (3,347)
<b>Attitude to speeding</b>	25.3 (8.77)	14.7 (7.24)	30.6 (9.28)	19.9 (9.54)	20.6 (8.58)
<b>Attitude to drink driving</b>	1.7 (2.50)	1.3 (2.04)	6.2 (4.26)	2.9 (3.08)	2.7 (2.71)
<b>Attitude to aggressive riding behaviour</b>	18.4 (17.72)	10.0 (10.46)	36.7 (20.54)	22.1 (14.78)	19.0 (12.47)
<b>Riding errors</b>	0.5 (0.91)	0.4 (0.78)	1.4 (1.75)	2.0 (2.62)	0.7 (1.40)
<b>Competition</b>	1.1 (1.40)	0.2 (0.52)	2.0 (1.95)	0.8 (1.26)	0.6 (1.03)
<b>Quickly getting ahead</b>	1.8 (1.30)	0.8 (1.09)	2.3 (1.63)	1.6 (1.63)	1.5 (1.38)
<b>Braking traffic rules</b>	2.9 (1.05)	2.2 (0.61)	3.3 (1.17)	2.7 (0.95)	2.6 (0.89)

## DISCUSSION

The current research project was the first study that identified subgroups of motorcyclists on the basis of personality characteristics. This was previously done for other road user groups especially for car drivers or young users of motorised vehicles. In summary in the current research project the clustering was successful and in line with the past research. The five clusters differed substantially in the underlying personality structure but also with regard to road safety relevant criteria. In our study Type 3 turned out to be most at risk of being involved in a motorcycle accident. These motorcyclists can be characterised as highly rejecting social norms, seeking for new and exciting experiences and having the disposition to show anger and frustration.

No other study before has identified subtypes of motorcyclists on the base of personality so it was not possible to compare the resulting cluster solution of the current research project with other personality types of motorcyclists. However, to some extent the results are comparable to the six subtypes of young drivers found by Ulleberg (2002). The characterisation of his Cluster 1, for example, is very similar to the one of Type 2 in this project. Drivers or riders in these groups seem to be emotionally well adjusted. They score low on excitement seeking, anxiety, hostility and normlessness, and they also care for the needs of others shown by high scores of altruism. Because of their little risky behaviour and attitudes Type 2 is not rated to be one of the most important target groups for traffic safety campaigns.

Ullebergs Cluster 2 matches to Type 3 in this study. Both groups are defined by high excitement seeking, hostility and normlessness and in the same time by low altruism. It means that these vehicle users are open to extreme experiences and are willing to show anger and aggressiveness while not caring for social norms or values and for the wellbeing of others. This combination seems to create a high traffic risk as in these groups are high numbers of accident involved and high scores for risky behaviour. Therefore Type 3 has to get into focus for further road safety measures.

Cluster 4 found by Ulleberg can be compared to Type 1 in the study at hand with a combination of high scores for excitement seeking but also high altruism. These riders did not show to be at high-risk to be involved in a motorcycle accident, but have the highest yearly travel distance with the second highest scores for risky attitudes and behaviour. Therefore this group should be addressed to as well in order to prevent themselves and other traffic users from danger.

Ullebergs Clusters 3, 5 and 6 are somehow variations of Type 4 and 5 found in this study. Cluster 5 is most similar to Type 4 describing vehicle users with above average scores for anxiety and hostility and low scores for altruism. Not caring for the wellbeing of others and tending to show anger and aggression might form a high-risk traffic user group which is

shown by the second high scores for the attitudes to drink driving and to aggressive behaviour. But due to a low yearly travel distance, likely coming from above average scores of anxiety, the motorcyclists of Type 4 do not have a high accident risk. Because of their risky attitudes they should not be disregarded when designing traffic safety measures. Cluster 6 and Type 5 both exceed moderate scores on all personality traits assessed besides one (Cluster 6: altruism; Type 5: normlessness). Though Type 5-riders do not seem to care for social norms or rules they do not form a traffic risk due to the lowest accident rate. Therefore, these motorcyclists don't have to be the main target of future traffic safety campaigns.

Ulleberg showed that the six clusters reacted differently on a traffic safety campaign. For example cluster 2 (high excitement seeking, hostility and normlessness and low altruism) rated this campaign the least positive. These drivers were more likely than the other clusters to find the campaign 'boring' or 'disappointing', and felt to a higher extent that the campaign did not concern them. The most positive ratings could be found for Clusters 1, 3 and 4. These cluster build the lower-risk groups. This finding supports the idea that traffic safety measures and especially campaigns have to be matched to the target group in order to achieve a benefit in road traffic safety.

## REFERENCES

- Bachoo, S., A. Bhagwanjee & K. Govender (2013). The influence of anger, impulsivity, sensation seeking and driver attitudes on risky driving behaviour among post-graduate university students in Durban, South Africa. *Accident Analysis and Prevention* 55, 67-76.
- Brandau, H., F. Daghofer, M. Hofmann & P. Spitzer (2011). Personality subtypes of young moped drivers, their relationship to risk-taking behavior and involvement in road crashes in an Austrian sample. *Accident Analysis and Prevention* 43, 1713-1719.
- Costa, P.T.jr. & R.R. McCrae (1992). Revised NEO Personality Inventory (NEO-PI-R) and NEO Five Factor Inventory (NEO-FF-I). Professional Manual. Psychological Assessment Resources Inc., Odessa.
- Donovan, D.M., R.L. Umlauf & P.M. Salzberg (1988). Derivation of personality subtypes among high-risk drivers. *Alcohol, Drugs, and Driving*, 4, 233-244.
- Elander, J., R. West & D. French (1993). Behavioural correlates of individual differences in road-traffic crash risk: An examination of methods and findings. *Psychological Bulletin* 113, 279-294.
- Elliott, M.A., C.J. Baughan & B.F. Sexton (2007). Errors and violations in relation to motorcyclists' crash risk. *Accident Analysis and Prevention* 39, 491-499.
- Herzberg, P.Y. & B. Schlag (2003). Sensation Seeking und Verhalten im Straßenverkehr. In: *Sensation Seeking – Konzeption, Diagnostik, Anwendung* (M. Roth & P. Hammelstein, eds.), pp. 162-182. Hogrefe, Göttingen.
- Hilakivi, I., J. Veilahti, P. Asplund, J. Sinivuo, L. Laitinen & K. Koskenvuo (1989). A sixteen-factor personality test for predicting automobile driving accidents of young drivers. *Accident Analysis and Prevention* 21, 413-418.
- Holte, H. (2012a). Einflussfaktoren auf das Fahrverhalten und das Unfallrisiko junger Fahrerinnen und Fahrer. *Berichte der Bundesanstalt für Straßenwesen, Mensch und Sicherheit*, Heft M 229. Wirtschaftsverlag NW, Bremerhaven.
- Holte, H. & I. Pfafferoth (2014). Wirkungsmechanismen und Erfolgsfaktoren von Verkehrssicherheitskampagnen. In: C. Klimmt et al. (Eds.) *Verkehrssicherheitskommunikation*. Springer VS, Wiesbaden.
- Iversen, H. & T. Rundmo (2002). Personality, risky driving and accident involvement among Norwegian drivers. *Personality and Individual Differences* 33, 1251-1263.
- Jonah, B.A. (1997). Sensation seeking and risky driving: A review and synthesis of the literature. *Accident Analysis and Prevention* 29, 651-665.

Kohn, M. & C. Schooler (1983). *Work and Personality: An Inquiry into the Impact of Social Stratification*. Norwood Ablex, New York.

Statistisches Bundesamt [Federal statistical office] (2014a). *Verkehrsunfälle. Unfallentwicklung im Straßenverkehr 2013*. Wiesbaden.

Statistisches Bundesamt [Federal statistical office] (2014b). *Verkehrsunfälle. Zweiradunfälle im Straßenverkehr 2013*. Wiesbaden.

Schulze, H. (1999). *Lebensstil; Freizeitstil und Verkehrsverhalten 18- bis 34-jähriger Verkehrsteilnehmer*. Berichte der Bundesanstalt für Straßenwesen. Mensch und Sicherheit, Heft M 103. Wirtschaftsverlag NW, Bremerhaven.

Reason, J., A. Manstead, S. Stradling, J. Baxter & K. Campbell (1990). Errors and violations on the roads: a real distinction? *Ergonomics* 33, 1315-1332.

Olteidal, S. & T. Rundmo (2006). The effects of personality and gender on risky driving behaviour and accident involvement. *Safety Science*, 44, 621-628.

Ostendorf, F. & A. Angleitner (2003). *NEO-Persönlichkeitsinventar nach Costa und McCrae, Revidierte Fassung (NEO-PI-R)*. Manual. Hogrefe, Göttingen.

Machin, M.A. & K.S. Sankey (2008). Relationships between young drivers' personality characteristics, risk perceptions, and driving behaviour. *Accident Analysis and Prevention* 40, 541-547.

Mannering, F.L. & L.L. Grodsky (1995). Statistical analysis of motorcyclists' perceived accident risk. *Accident Analysis and Prevention* 27, 21-31.

Ulleberg, P. (2002). *Influencing subgroups of young drivers and their passengers. Motivational influences of personality traits on risk-taking attitudes and driving behaviour*. Dissertation, Trondheim.

Watson, B., D. Tunnicliff, K. White, C. Schonfeld & D. Wishart (2007). *Psychological and social factors influencing motorcycle rider intentions and behaviour*. Australian Transport Safety Bureau, Canberra, Australia.

Wong, J.-T., Y.-S. Chung & S.-H. Huang (2010). Determinants behind young motorcyclists' risky riding behavior. *Accident Analysis and Prevention* 42, 275-281.