Personality subtypes of young moped drivers, their relationship to risk-taking behavior and involvement in road crashes in an Austrian sample

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Objective: This study aimed to identify subtypes of young moped drivers and analyze how these subtypes are involved in risk preferences and road crashes.

Design: A group of Austrian teenage moped drivers (213, 28% girls) completed an online questionnaire about moped usage, injuries, driving style, inattention, impulsivity, and personality according to the Five-Factor Model of Personality and Cloninger’s model of personality.

Results: A cluster analysis yielded four types of moped drivers. One type was characterized by a high level of neuroticism, the second type was characterized by a risky personality and a risky driving style, the third type had a more cautious driving style, and the fourth type was characterized by a risky personality and high levels on inattention and impulsivity.

Conclusions: Our conclusions suggest that young moped drivers should not be perceived as a homogenous group, according to measures of injury prevention and intervention.

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1. Introduction

Young moped drivers are a group at high risk for injuries caused by road crashes. In his 1999 paper, Kopjar raised the question of whether moped injuries among adolescents are a significant forgotten problem. In the 1970s and early 1980s, there was an interest in the study of safety for moped drivers, which, however, vanished after the use of safety helmets became mandatory in many countries (Kopjar, 1999). Moped injuries tend to be severe, with a strong tendency of serious injuries to the head (Matysz and Karlsson, 1986).

The barriers to obtaining a moped driving license have changed in Austria. Some legal restrictions for 15-year-old teenagers have been removed. The effect of these changes was that the relative number of moped driving license owners rose from 6% in the year 2000 up to 38% in the year 2008 within this age group. This huge rise in the number of adolescent moped drivers resulted in a dramatic increase of accidents and injuries. In 2000, the percent of injured 15 year olds moped drivers within the group of all moped traffic accidents was 6%; in 2008, it was approximately 32%. This dramatic increase of the absolute number of accidents attracted public and governmental attention. Hence, the needs for research and investigation into risk experience and risk behavior of 15-year-old teenage moped drivers entered the political and traffic-safety agenda.

Currently, the number of road crashes for 15-year-old is approximately as high as that of 16-year-old. Along with the rise in the number of crashes for 15 year olds, the number for 16 year olds has not decreased over the last few years, although a decrease was expected due to the extra year of driving experience (Spitzer, 2009).

The hypothesized main factors for the high injury rate are insufficient skills, lack of experience, overestimation of their own driving skills (Deery and Fildes, 1999; Moe, 1986), biases in risk perception (Gregersen and Bjurulf, 1996), expression of a generally risky lifestyle, and certain personality characteristics. Sensation-seeking (Zuckerman, 1994) and novelty-seeking (Cloninger, 1994) desires indicate a need to experience novelty and a risky lifestyle. Risky driving and accident involvement is a result of this need (Jonah, 1997).

There are many studies investigating the relationships between the personality traits of the well-known and empirically established Big Five model (Costa and McCrae, 1992) and road-crash involvement. Meta-analytic reviews of this link (Clarke and Robertson, 2005; Lawton and Parker, 1998) show a slightly to moderately positive correlation with crash involvement. The results indicate that low agreeableness and low conscientiousness are valid predictors of injury-risk, whereas neuroticism has a small effect (rhoo = 0.20). Clarke and Robertson (2005) showed that, despite not demonstrating validity generalization, openness had the largest mean correlation (rhoo = 0.34) with the occurrence of crashes. Are
people who are more open to experience more involved in traffic crashes? Are these people sensation seekers? Wallace and Vodanovich (2003) found that people with different personality profiles were involved in different settings when receiving injuries; for example, extraversion is related to road but not occupational accidents (Lajunen, 2001). Persons with clinically diagnosed attention-deficit hyperactivity disorder (ADHD) are significantly more accident-prone (Barkey et al., 1996; Di Scala et al., 1998). This group of people is not only injured more often but also receives more severe injuries. However, Brandau (2004) has shown that only a specific subgroup of high-novelty seekers in the spectrum of ADHD is more accident-prone.

Studies applying personality and clinically relevant variables usually focus on the separate influence of each variable to predict accident involvement. A more plausible method of identifying high-risk drivers is the exploration of specific subtypes on the basis of combinations of certain characteristics. Only a few studies have identified such subtypes using cluster analysis. Donovan et al. (1988) found three clusters of high-risk drivers, Wilson (1991) found four clusters, and Deery and Fildes (1999) identified five subtypes with two of these being high-risk groups. One of the two high-risk groups was characterized by high levels of sensation seeking, hostility, assaultiveness, and driving-related aggression; the other showed high levels of depression and irritability and a low level of emotional adjustment. Among the high-risk groups, 80% were males. Ulleberg (2001) found six subtypes of young drivers including two high-risk types, one labeled “sensation-seekers”, and the other labeled “normless”. The subtypes differed on how they responded to a traffic-safety campaign. The campaign appealed most to low-risk subtypes. The author concluded that young drivers should not be treated as a homogeneous group.

The major aim of the present study is to identify subtypes of young moped drivers on the basis of a cluster analysis of personality characteristics, including the Big Five Model; dimensions of ADHD according to DSM IV; and the three variables in Cloninger’s model (1994): novelty seeking, risk avoidance, and reward dependence. The main questions are as follows:

- Are there differences in risk taking (e.g., illegally tuning up the engine to increase top speed) and injury severity among the different subtypes? Are the subtypes in a sample of young moped drivers similar to the subtypes already found in other studies? What are the implications of the results for the moped examination and how should the different subgroups be treated?

### 2. Method

#### 2.1. Sample

The sample was a field sample of 213 Austrian teenage moped drivers out of a total of 507 juveniles between the ages of 14 and 17. There were 59 girls and 159 boys. The mean age was 15.3 years (SD = 0.96; median = 15), and no statistically significant differences in age were found between boys and girls (t-test \( p = .48 \)). The participants were recruited from local schools in the district of Styria representing all possible school types for this age group. Schools were randomly selected from urban and rural regions. The inclusion criterion for the field sample used in the calculations was a positive response to driving a moped. Parents and official school administrators gave permission for voluntary participation in the study. The participants completed the online questionnaire at school during their regular school time and were not compensated.

#### 2.2. Materials

The participants completed an online questionnaire including the following topics:

1. demographic data;
2. moped usage (kilometers per year) and self-induced injuries while driving the moped (no injury, injury without the need of a clinical treatment, and injury with the need of a clinical treatment);
3. Asendorpf and Van Aken’s (2003) adjective checklist/questionnaire to assess personality according to the Five-Factor Model of Personality;
4. a questionnaire constructed by the researcher to assess personality according to Cloninger’s (1994) three-dimensional model of personality. This form is a 15-item, self-rating version of the German parent-rating short form developed by Brandau and Daghofer (2010), which is an age-specific adaption of Cloninger’s three-dimensional personality questionnaire. In this version, Cloninger’s dimension “harm avoidance” is reversely formulated and labeled “risk taking.” The parent-rating version of Cloninger’s three-dimensional model was validated by a comparison of the test scores between normal controls and children who were repeatedly injured by severe self-caused accidents. To examine the construct validity of our self-rating form, the following analyses were carried out.

Internal consistency was measured by Cronbach’s coefficient Alpha and yielded satisfactory results for the three scales (Alpha ranged from 0.72 to 0.74; see Table 1).

An exploratory and a confirmatory factor analysis were performed. We used the principal components analysis as the method of factor extraction in the exploratory factor analysis. In addition, an orthogonal factor rotation according to the Varimax procedure was carried out. The results from this analysis were very comparable to the findings by Brandau and Daghofer (2010). According to the eigenvalue criterion, three factors were extracted, and the postulated scale structure could be clearly identified in the rotated

| Table 1 Correlations among the personality scales. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Novelty seeking | .74 | | | | | | | | | |
| 2. Risk taking | .48 | | | | | | | | | |
| 3. Reward dependence | .58 | .58 | | | | | | | | |
| 4. Extraversion | .08 | .15 | -.11 | | | | | | | |
| 5. Neuroticism | .17 | -.09 | .22 | -.60 | | | | | | |
| 6. Conscientiousness | -.41 | -.29 | -.31 | .11 | | | | | | |
| 7. Agreeableness | -.18 | -.35 | -.24 | .17 | | | | | | |
| 8. Openness | -.29 | -.15 | -.20 | .40 | | | | | | |
| 9. Inattention | .62 | .45 | .63 | -.13 | .25 | | | | | |
| 10. Impulsivity | .57 | .55 | .63 | -.03 | .12 | .34 | | | | |

Note. Cronbach’s \( \alpha \) in the main diagonal.

\( * p < .05 \)

\( ** p < .01 \)
solution. The three factors were accounted for 50% of the explained variance. Factor 1 could be identified as novelty seeking. The five items of this scale had loadings ranging from .47 to .79. For the second factor, the five items of the risk taking scale had the highest loadings, which ranged from .42 to .71. For the third factor, the five items to assess reward dependence had the highest loadings, which ranged from .36 to .71.

In the confirmatory factor analysis, the Robust Maximum-Likelihood method was used for parameter estimations. Following the suggestions made by Bollen (1989) and Marsh et al. (1996), several indices of model fit were considered. In particular, the non-normed fit index (NNFI) should be greater than or equal to .90 (Marsh et al., 1996), the root mean square error of approximation (RMSEA) should be less than or equal to .06 (Hu and Bentler, 1998), and the standardized root-mean-square residual (SRMR) should be less than or equal to .05 (Spence, 1997). With the exception of the SRMR, which failed to reach the criterion by a small amount, we found a good approximation to the postulated scale structure: the NNFI was .99, the RMSEA .03 (90% confidence interval ranged from 0 to .05), and the SRMR was .06. The standardized path coefficients of the novelty seeking-items ranged from .33 to .79, those of the risk taking-items from .56 to .85, and those of the reward dependence-items from .59 to .72. All standardized path coefficients were statistically significant with p-values less than .001.

We also compared the patterns of scale intercorrelations and the correlations of the three scales with the Big-Five dimensions in our study sample with the values reported by Brandau and Daghofer (2010) using a z-test for the comparison of correlations obtained from independent samples. No statistically significant differences were found for the correlations among the three scales novelty seeking, risk taking, and reward dependence. With respect to the correlations between the three scales with the Big Five, we found five statistically significant differences in the magnitude of the correlation. In four of these cases, we found a lower correlation but with the same sign in our sample. With respect to the correlation between risk taking and neuroticism, however, the relation was different direction. While Brandau and Daghofer (2010) found a low but positive correlation (r = .21), we obtained a small negative value (r = -.09), which means that a low level of risk taking corresponds to high harm avoidance.

Additionally, we correlated the three dimensions of Cloninger with the self-reported information about suffering from an injury while driving the moped as an external criterion of validity. We correlated the scale with the participants' self-reported information about suffering from an injury while driving the moped and found a correlation of .26 (p < .001). In addition, we correlated this scale with the participants' self-reported information about illegally tuning up the engine to increase top speed and found a correlation of .42 (p < .001).

A self-constructed scale by the researcher to assess a risky driving style (16 items; example items: I turn onto a street with my moped even if there is a car near to me; I use dangerous streets (e.g., blind spots, high traffic intensity); only fast driving is good driving). The internal consistency of this scale, measured in terms of Cronbach's Alpha, yielded a satisfactory reliability of 0.87. As a measure of validity, we correlated the scale with the participants' self-reported information about suffering from an injury while driving the moped and found a correlation of .26 (p < .001). In addition, we correlated this scale with the participants' self-reported information about illegally tuning up the engine to increase top speed and found a correlation of .42 (p < .001).

A self-constructed questionnaire by the researcher to assess the participants' estimation of danger for 10 typical traffic situations (10 items; example items: cutting corners; driving without a helmet; ignoring the precedence at a blind crossing). Cronbach's Alpha for this scale yielded a good reliability coefficient of .91. This scale had statistically significant correlations to novelty seeking (r = -.18, p = .008), risk taking (r = -.24, p < .001), reward dependence (r = -.16, p = .020), and the Big Five dimensions of conscientiousness (r = .26, p < .001), agreeableness (r = .32, p < .001), and openness (r = .27, p < .001). However, it was not correlated to injuries while driving a moped. It seems that this measure is connected to personality rather than behavior.

2.3. Statistical analysis

Pearson correlations were carried out to measure the relations among the scales. A hierarchical cluster analysis, using Ward's method, was performed with the z-standardized personality scales. A structogram was used to determine the number of clusters. The initial cluster solution was improved by applying the k-means clustering algorithm. Differences between the cluster types were analyzed by means of the χ²-test for categorical variables and the one-way analysis of variance for metric variables, respectively. Logistic regression analyses were carried out to predict the risk of being involved in an injury (injury without the need of clinical treatment versus no injury, injury needing clinical treatment versus no injury, and injury needing clinical treatment versus injury without the need of clinical treatment). The level of significance testing was determined at .05. Because there were three logistic regression analyses performed, a Bonferroni correction for the model significance was applied to these analyses. As measures of effect size, we computed the η² coefficient in addition to the analysis of variance and the coefficient w in addition to the χ²-test, respectively.

3. Results

3.1. Correlations among the scales and internal consistencies

Table 1 shows the correlations among the scales and Cronbach’s reliability coefficient α. As expected from the results of earlier works, the dimensions of novelty seeking, risk taking, and reward dependence were related, with correlations ranging from .48 to .58. A high negative correlation was also found between the Big-Five dimensions of extraversion and neuroticism. The other relations among the Big-Five scales were low to moderate. A high correlation was found between inattention and impulsivity, indicating that these domains were not unrelated. Additionally, inattention and impulsivity were highly related to novelty seeking and reward dependence, and there was also a high correlation between impulsivity and risk taking.

3.2. Cluster analysis

The visual inspection of the structogram of the cluster analysis yielded a solution with four types. Table 2 shows the z-standardized cluster profiles among the scales (see also Fig. 1). Type 1 was characterized by a high level of neuroticism (approximately one standard deviation above average), a low level of extraversion (approximately one standard deviation below average), and a lower level of openness (more than half a unit of the total standard deviation below average). Type 2 was characterized by higher scores for risk taking and extraversion. Type 3 was characterized by low levels of novelty seeking, risk taking, reward dependence, neuroticism, inattention, and impulsivity (more than half a unit of the total standard deviation below average) but higher scores for conscientiousness.
Table 2
Type profiles.

<table>
<thead>
<tr>
<th>Type</th>
<th>M (N=50)</th>
<th>SD</th>
<th>M (N=59)</th>
<th>SD</th>
<th>M (N=75)</th>
<th>SD</th>
<th>M (N=29)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novelty seeking</td>
<td>−0.05</td>
<td>0.86</td>
<td>0.29</td>
<td>0.74</td>
<td>−0.70</td>
<td>0.53</td>
<td>1.30</td>
<td>1.09</td>
</tr>
<tr>
<td>Risk taking</td>
<td>−0.45</td>
<td>0.80</td>
<td>0.63</td>
<td>0.68</td>
<td>−0.61</td>
<td>0.73</td>
<td>1.06</td>
<td>0.85</td>
</tr>
<tr>
<td>Reward dependence</td>
<td>−0.21</td>
<td>0.78</td>
<td>0.34</td>
<td>0.79</td>
<td>−0.66</td>
<td>0.71</td>
<td>1.38</td>
<td>0.64</td>
</tr>
<tr>
<td>Extraversion</td>
<td>−0.99</td>
<td>0.85</td>
<td>0.50</td>
<td>0.73</td>
<td>0.39</td>
<td>0.79</td>
<td>−0.31</td>
<td>0.88</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>1.07</td>
<td>0.88</td>
<td>0.81</td>
<td>0.60</td>
<td>−0.56</td>
<td>0.67</td>
<td>0.47</td>
<td>0.88</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>−0.30</td>
<td>0.93</td>
<td>−0.26</td>
<td>0.80</td>
<td>0.73</td>
<td>0.70</td>
<td>−0.85</td>
<td>0.99</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>−0.15</td>
<td>0.92</td>
<td>−0.19</td>
<td>0.93</td>
<td>0.57</td>
<td>0.83</td>
<td>−0.83</td>
<td>0.90</td>
</tr>
<tr>
<td>Openness</td>
<td>−0.65</td>
<td>0.78</td>
<td>0.37</td>
<td>0.65</td>
<td>0.53</td>
<td>0.76</td>
<td>−1.01</td>
<td>1.13</td>
</tr>
<tr>
<td>Inattention</td>
<td>−0.02</td>
<td>0.80</td>
<td>0.11</td>
<td>0.67</td>
<td>−0.66</td>
<td>0.63</td>
<td>1.57</td>
<td>0.82</td>
</tr>
<tr>
<td>Impulsivity</td>
<td>−0.27</td>
<td>0.71</td>
<td>0.31</td>
<td>0.72</td>
<td>−0.63</td>
<td>0.57</td>
<td>1.47</td>
<td>1.04</td>
</tr>
</tbody>
</table>

Note: All variables were z-standardized.

Table 3
Differences between personality types in gender, age, type of school, kilometers driven per year, injury while driving the moped, illegally tuning up the engine, risky driving style, and danger estimation.

<table>
<thead>
<tr>
<th>Type</th>
<th>Gender</th>
<th>Age (Mean ± SD)</th>
<th>Type of school</th>
<th>Kilometers per year</th>
<th>Injury while driving the moped</th>
<th>Mean of risky driving style (SD)</th>
<th>Mean of danger estimation (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Girls</td>
<td>15.21 ± 0.97</td>
<td>Polytechnic &amp; vocational school</td>
<td>21 ± 4.60</td>
<td>None</td>
<td>1.96 ± 0.63</td>
<td>2.85 ± 0.79</td>
</tr>
<tr>
<td></td>
<td>Boys</td>
<td>15.40 ± 0.97</td>
<td>Grammar &amp; Secondary school</td>
<td>22 ± 3.70</td>
<td>Injury without clinical treatment</td>
<td>2.35 ± 0.58</td>
<td>2.90 ± 0.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.37 ± 0.92</td>
<td>Kilometers per year</td>
<td>23 ± 3.10</td>
<td>Injury with clinical treatment</td>
<td>1.82 ± 0.60</td>
<td>3.16 ± 0.58</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14.81 ± 0.96</td>
<td>Injury while driving the moped</td>
<td>26 ± 3.10</td>
<td>Mean of risky driving style (SD)</td>
<td>2.69 ± 0.51</td>
<td>2.67 ± 0.85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.27 ± 0.96</td>
<td>Mean of danger estimation (SD)</td>
<td>148 ± 30.00</td>
<td>Mean of danger estimation (SD)</td>
<td>117 ± 58.00</td>
<td>2.95 ± 0.69</td>
</tr>
</tbody>
</table>

Note: Different letters indicate statistically significant mean differences at the 5% level (Tukey’s HSD).

3.3. Differences between the types

No statistically significant differences between the types were found in gender, type of school, and number of kilometers driven with the moped per year (see Table 3). There were statistically significant differences with a small effect in age; Type 4 moped drivers were younger than Type 2 drivers. Additionally, we found signifi-
The results of the cluster analysis show four subtypes of moped drivers. The clusters were found to differ on several injury risk-related measures. Two of the clusters were characterized by high injury risk, especially Type 4, with the highest rate of severe injuries. The members of this cluster show high impulsivity, inattentiveness, novelty seeking, and reward dependence, and describe themselves as prone to high-risk behavior.

Compared to Type 3, which indicates good emotional adjustment, Type 1 has a higher risk for severe injuries than for injuries without the need of clinical treatment, Type 2 has a higher risk for having injuries without the need of clinical treatment than having none, and Type 4 has a higher risk for severe injuries than having none.

There is no study with young moped drivers that can be used as a comparison basis, but the profiles of high-risk clusters were similar to high-risk groups in previous studies related to risk behavior in the context of accidents, such as Donovan et al. (1988), who found three high-risk subtypes. The first subtype, characterized by high levels of impulsiveness, sensation seeking, and assaultiveness, is in a way comparable to our Type 4 cluster. The second subtype showed significant differences between the types with a small effect in the form of injury. The most remarkable deviation between observed and expected frequencies was found in Type 2, which had the highest rate of injuries without the need of clinical treatment (58%). On the other hand, 55% of Type 3 drivers reported no injury while driving the moped. The highest rate of injuries that needed additional clinical treatment was found for Type 4 (21%), followed by Type 1 (18%; see Table 3). Regarding self-estimated risky-driving style, there were statistically significant differences between the types with a strong effect. The most risky drivers were Type 4 drivers, followed by Type 2 drivers, whereas no differences were found between Type 1 and Type 3 drivers. In addition, we also found slight differences on danger estimation. Type 4 drivers rated the given situations as less dangerous than Type 3 drivers (see Table 3).

All three logistic regression models for predicting the risk of being involved in an injury were statistically significant (model p's were less than .011). Table 4 shows the results for the predictors. Because the personality type was a categorical variable with four levels, we used three dummy variables in the logistic regression, referencing Types 1, 2, and 4 against Type 3, which was found to be the most cautious type of driver. In addition, the highest parental education had four levels and was coded with three dummy variables. When comparing moped drivers who had an injury without the need of clinical treatment with those who had no injury, statistically significant predictors were age and personality type, which was the strongest predictor. Being a member of Type 2 increased the risk of having an injury without the need of clinical treatment by more than two times compared to being a member of Type 3. When comparing moped drivers who had an injury needing clinical treatment to those who had no injury, age and personality type were found to be statistically significant predictors. As shown in Table 4, the relative risk of having an injury needing clinical treatment increased by more than four times for members of Type 4 when compared with members of Type 3. When comparing moped drivers who had an injury needing clinical treatment against those who had an injury without the need of clinical treatment, age and personality type were statistically significant predictors. According to the relative risk, this analysis also found personality type to be the second strongest predictor for indicating the risk of having an injury needing clinical treatment increased for members of Type 1 compared with members of Type 3. Another main predictor was the highest parental education.

### 4. Discussion

The results of the cluster analysis show four subtypes of moped drivers. The clusters were found to differ on several injury risk-related measures. Two of the clusters were characterized by high injury risk, especially Type 4, with the highest rate of severe injuries. The members of this cluster show high impulsivity, inattentiveness, novelty seeking, and reward dependence, and describe themselves as prone to high-risk behavior.

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low emotional adjustment, depression and hostility, which is in a way comparable to our cluster Type 1. The third was well adjusted, similar to our Type 3 cluster. Wilson (1991) found four clusters and Deery and Fildes (1999) identified five subtypes of young car drivers with two high-risk groups: high levels of sensation seeking, aggressiveness, and driving-related aggression and high levels of irritability and depression. The latter group could be compared to our Type 1 cluster. While our Type 4 cluster could also be found in these other studies, no other study found a type that could be compared with our Type 2 cluster, which is characterized by higher levels of risk taking, openness, and extraversion. One question of interest is whether a higher level of openness prevents severe injuries. With respect to danger estimation, this type does not differ from the adjusted Type 3. Although the clusters should not be seen as an objective classification of young moped drivers, independent from sample characteristics and personality variables, there are some common features in the results: (1) the existence of three to five cluster types and (2) similarities in the profiles.

Are personality factors stronger predictors of injury risk than gender?

Contrary to other studies (e.g., Ulleberg, 2001), we did not find gender differences between the subtypes of personality. When predicting the risk of having an injury while driving the moped, we found that the personality subtype had a much stronger effect than gender in our sample of teenage moped drivers. However, we found a lower rate of female moped drivers than male moped drivers in our sample. Quite possibly, young female moped drivers are characterized by higher levels of risk taking than female non-moped drivers.

Our results show that, among those involved in a traffic crash, moped drivers whose parents have a low education level have a greater risk of severe injuries than those whose parents have higher levels of education (see also Hasselberg et al., 2001).

No differences in attitudes towards theoretical and practical part of the driving education program were found between the types.

Whether our types (4 and 1) are least responsible to safety messages and programs could not be determined, but the results of Ulleberg (2001) point out towards.

4.1. Strengths and limitations

We identified a sub group of teenage moped drivers that are statistically more likely to be involved in a crash and are at high risk for injuries while driving the moped based on the data of a representative filed sample. One weakness is the lack of situational variables in the context of the crashes. In addition, the relations between personality and situational context factors (weather, road condition) were not considered. With respect to the use of cluster analysis, there are many different methods of finding clusters, which may lead to different numbers and/or characteristics of the types. Another weakness is that one of the personality scales (openness) was found to be unreliable. In general, the study relied on self-reported information and may be subject to self-judgement bias. Future research would benefit from observed traffic behavior as a criterion of validity, especially with respect to measures like danger estimation and risky driving style.

4.2. Implications

The results suggest that measures of traffic safety should be differentiated and individualized. It makes little sense to treat young moped drivers as a homogenous group.

Therefore, interventions should be tailored to the personality characteristics and motivation of the subtypes. Three strategies can be used: enforcement, engineering, and education.

Enforcement: (1) Sanctions, such as graduated licensing, could be used (see Ulleberg, 2001). The underlying motivation for risk involvement is rarely changed by sanctions for this group of young people. (2) We found that 53% of moped drivers in our sample illegally tuned up the engine. Therefore, stricter controls are necessary to prevent crashes caused by high speed.

Education: (1) Specific interventions on the personal level to empower and enhance risk-management abilities let young drivers discover the need for changes in attitudes and behavior (Gregersen and Berg, 1994). (2) Peer interventions encourage peer influence to promote safe driving (Amundsen et al., 1999). An especially strong influence of group dynamics for risk behavior is an essential aspect. (3) High level of impulsivity, inattentiveness, and low agreeableness and conscientiousness demand the training of emotion regulation, relaxation, and attention control (Deffenbacher et al., 2000). (4) Lifestyle interventions (Jessor, 1987) because risky driving for some young people is part of their lifestyle. Risky driving is connected with other problem behaviors, such as drinking and drug abuse, aggression against authorities, and delinquency. In such an intensive individualized program, drivers themselves discover the need for behavioral change and are coached to draw their own conclusions about how they can change (Brehmer et al., 1993). (5) Mastery and coping with difficult and complex risk situations with special multimedia-based learning software to simulate dangerous situations under controlled conditions. (6) A training program for a moped driving license should be designed as a multi-phase training (Spitzer, 2009). The theoretical part should be carried out alternatively with the practical part. During the last part of the practical training, an interview shall be carried out to recheck the knowledge of rules and regulations. Within 6 months of having received the driving license, a feedback driving experience should be performed.

(7) In the context of education and training for a better understanding and assessment of safety and risks, it is necessary to introduce obligatory classes within school life. Therefore, 10–14 year olds have a chance to achieve better self-assessment and risk-competence skills (Spitzer, 2009).

In case of severe patterns of clinically diagnosed ADHD, driving performance could be improved by medication (e.g., Cox et al., 2004). However, further research is needed to evaluate the effects of medication for injury prevention in adolescents with ADHD.

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