**PISa**  
Powered Two Wheeler Integrated safety

<table>
<thead>
<tr>
<th>Deliverable no.</th>
<th>D12 User Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissemination level</td>
<td>Public</td>
</tr>
<tr>
<td>Task Package</td>
<td>Task 2.2.3</td>
</tr>
<tr>
<td>Author(s) and Partner name</td>
<td>Pauwelussen, Oudenhuijzen, TNO</td>
</tr>
<tr>
<td>Co-author(s) and Partner name</td>
<td>Pierini, Savino, UNIFI, Peldschus, LMU, StClair, TRL</td>
</tr>
<tr>
<td>File Name</td>
<td>D12_User_Information_Finaldraft.doc</td>
</tr>
<tr>
<td>Project Start Date and Duration</td>
<td>PM 01- PM 10</td>
</tr>
</tbody>
</table>
Executive Summary

This report discusses the results of a user information survey concerning safety systems on PTWs (Powered Two Wheelers) to obtain insight in the present usage of PTWs and the demand and acceptance for new safety systems for Germany (D), Italy (I) and the Netherlands (NL). Additional information from an extensive UK survey was also analysed. This data allowed survey information to be related to existing data sources and to investigate the trends in PTW accidents. This analysis was used to relate rider characteristics to accident risk and to the user acceptance of systems.

The participants of all the three different countries drove often on rural roads, quite often on urban roads, sometimes on motorways and hardly ever on unpaved roads. The German participants drove less frequently on urban roads compared to the other two countries and the Dutch participants drove more frequently on motorways compared to the other two countries.

The driving circumstances differed amongst all three different countries: the participants drove mostly in fair weather and during daytime. However the Italian participants drove more frequently during night and twilight compared to the other two countries.

The results showed that German and Dutch participants drove less reckless than the Italian participants. It was also shown that the participants that owning a sport PTW drove more reckless than the participants that drove other PTWs.

In the UK, two main groups of riders were identified; those who ride in all conditions throughout the year, including in the wet and dark, and those who ride in all conditions during the summer, but do not ride in the winter. The former have a much higher probability of accident involvement than the latter. The survey data suggests that the characteristics of the average EU survey and those of the UK are similar.

It could be concluded that the protection that is most often worn is of the following order:

1. Helmet
2. Motor jacket, motor gloves
3. Boots, motor suit
4. Motor trousers, earplugs, body protector, knee pads and kidney belt

Overall, the Italian participants seemed to wear less protection compared to the German and Dutch participants.

The outcome of the questionnaires referring to the desired systems showed that the PTW drivers were in favour for direct driving support systems such as ABS, ESP, Night vision displays etc. Automatic support systems, taking away tasks from the PTW driver were disliked. It also seemed that the Italian drivers were more interested in the enhanced vision/night vision display than the other two countries. This could be related to the circumstances that the participants drove in. The Italian drove more during night and twilight than German and Dutch participants.

A disparity may exist between user acceptance and the potential benefit of safety systems due to the perception of systems, the motivation of PTW riding and the accident liability for rider groups. However, APHS systems may be the most viable for implementation and could provide the most immediate safety benefits. CWS systems should be prioritised towards inexperienced riders who have reduced hazard perception and observational skills and a high accident liability. This group may also have the least opposition to new safety systems. Although generally considered undesirable, ADTS systems should be focused towards particular user groups since the acceptance, functionality and therefore safety benefit is somewhat dependent on the purpose of riding.
Summary

1 Introduction

2 User Information from Questionnaire
   2.1 Methodology
   2.2 Questionnaire

3 Results and analysis
   3.1 Demographic information
      3.1.1 Personal PTW driver information
      3.1.2 PTW make
      3.1.3 PTW type
   3.2 Driving experience
      3.2.1 Driving licenses
   3.3 Opinion towards awareness of other traffic w.r.t PTWs
   3.4 Driven trajectories
   3.5 Circumstances
   3.6 Reason for driving a PTW
   3.7 Driving style
   3.8 Protection of the participants
   3.9 Desired systems to improve safety
      3.9.1 Automatic Handling & Protection Systems
      3.9.2 Collision Warning Systems
      3.9.3 Advanced Driving Task Support

4 UK User Information Data
   4.1 UK Survey methodology
   4.2 Rider Characteristics
      4.2.1 Age
      4.2.2 Distance travelled
      4.2.3 Experience
      4.2.4 Size of bike
      4.2.5 Bike use
   4.3 Accident characteristics
   4.4 Motorcycling risk factors
      4.4.1 Exposure to risk
      4.4.2 Engine size and type of bike
      4.4.3 Type of experience/exposure
      4.4.4 Rider type, attitude and behaviour
   4.5 Summary of UK survey and analysis

5 Discussion of UK data (comparison with European survey data)

6 Conclusions

7 References

8 Appendix
Summary

This report discusses the results of a user information survey concerning safety systems on PTWs (Powered Two Wheelers) to obtain insight in the present usage of PTWs and the demand and acceptance for new safety systems. This User Information study was conducted in three different countries in the period between August 2006 and January 2007. These countries were Germany (D), Italy (I) and the Netherlands (NL). The total number of correspondents cannot be regarded as being representative for the group PTW drivers in the EU because of the limited amount of countries involved in this study (only GE, I and NL) and also for the concentration of correspondents for Italy and Germany (close to Munich). However, it provides user information for a large group of different types of riders from Germany, Italy and the Netherlands.

A UK survey of 30,000 current motorcyclists who were registered as, private-owner, motorcycle keepers in the UK was also reviewed. The survey data was related to existing data sources to investigate the trends in motorcycle accidents in order that rider characteristics could be related to accident risk and to the user acceptance. The survey achieved an 11,360 (40%) response rate. Given the high response rate and random sampling, this survey provides a good representation of the UK PTW user population. The UK survey was compared with the PISa survey to consider the similarities and differences and to get an insight in the relation between the examined user information and accident risks.

The participants of all the three different countries drove often on rural roads, quite often on urban roads, sometimes on motorways and hardly ever on unpaved roads. The German participants drove less frequently on urban roads compared to the other two countries and the Dutch participants drove more frequently on motorways compared to the other two countries.

The driving circumstances differed amongst all three different countries: the participants drove always in fair weather and during daytime, often during twilight and in queued traffic, quite often during night and in the rain and hardly ever in the snow. The Italian participants drove more frequently during night and twilight compared to the other two countries and the German participants drove less frequently (hardly ever) in rain and snow compared to the other two countries.

The German participants drove mainly for fun. For the Dutch participants it seemed that the participants that drove a sport PTW, roadster, a cruiser or an off-road PTW, drove also mainly for fun. The participants that had a touring PTW drove mainly for economical reasons.

With the scooter drivers included it seemed that the Italian drivers that drove a sport PTW, touring PTW, roadster, a cruiser or an off-road PTW, drove mainly for fun. The participants that had a scooter with an engine size of less than 250cc or a scooter with an engine size of more than 250cc drove mainly for economical reasons. Additionally, there was no clear relation found between the reason for driving a PTW and the amount of driven kilometres, the different road types that were driven and the different circumstances.

The analysis for all data excluding the scooter drivers showed that the German and Dutch participants drove less recklessly than the Italian participants. It was also shown that the participants that drove a sport PTW drove more recklessly than the participants that drove a touring PTW or a cruiser. The participants that drove a roadster or an off-road PTW drove also more recklessly than participants with a cruiser.

The analysis including scooter illustrated that the participants that had sport PTW), an off-road PTW, a scooter with an engine size of less than 250cc or a scooter with an engine size of more than 250cc drove more recklessly than participants that had a cruiser.
In the UK, two main groups of riders were identified: those who ride in all conditions throughout the year, including in the wet and dark, and those who ride in all conditions during the summer, but do not ride in the winter. The former have a much higher probability of accident involvement than the latter. The survey data suggests that the characteristics of the average EU survey and those of the UK are similar.

It could be concluded that the protection that is most often worn is of the following order:

1. Helmet
2. Motor jacket, motor gloves
3. Boots, motor suit
4. Motor trousers, earplugs, body protector, knee pads and kidney belt

Overall, the Italian participants seemed to wear less protection compared to the German and Dutch participants.

The outcome of the questionnaires referring to the desired systems showed that the PTW drivers were in favour for direct driving support systems such as ABS, ESP, Night vision displays etc. Automatic support systems, taking away tasks from the PTW driver were disliked. It also seemed that the Italian drivers were more interested in the enhanced vision/night vision display than the other two countries. This could be related to the circumstances that the participants drove in. The Italian drove more during night and twilight than German and Dutch participants.

A disparity may exist between user acceptance and the potential benefit of the APHS systems due to the perception of systems, the motivation of PTW riding and the accident liability for rider groups. However, ABS and ESP may be the most viable for implementation and could provide the most immediate safety benefits. CWS systems should be prioritised towards inexperienced riders who have a high accident liability due to reduced hazard perception and observational skills and may have a reduced opposition to CWS safety systems. Although generally considered undesirable, ADTS systems should be focused towards particular user groups since the acceptance, functionality and therefore safety benefit is somewhat dependent on the purpose of riding.
1 Introduction

This report contains the final results from a user information survey concerning safety systems on PTWs (Powered Two Wheelers). For this survey, a questionnaire was developed containing three categories. The first category contained questions about demographics of the targeted PTW drivers. The second category contained questions about their driver experience. The last category asked for preference for various driver support systems as well as the drivers estimate on how much they would spend on these systems. These data will be used to obtain insight in the present usage of PTWs and the demand and acceptance for new safety systems.

This User Information study was conducted in three different countries in the period between August 2006 and January 2007. These countries were Germany (D), Italy (I) and the Netherlands (NL).

A similar survey of current motorcyclists in the UK was also reviewed. The survey data was related to existing data sources to investigate the trends in PTW accidents in order that rider characteristics could be related to accident risk and to the user acceptance. The survey achieved an 11,360 (40%) response rate and provides a good representation of the UK PTW user population.
2 User Information from Questionnaire

2.1 Methodology
The user information was collected using questionnaires. The questionnaire was translated in Dutch, English, German and Italian and handed out, personally, in Germany, Italy and the Netherlands. In total 261 PTW drivers participated and completed the questionnaire. In Germany (D) 68 PTW drivers participated, in Italy (I) 100 and in the Netherlands (NL) 93.

For the German part of the survey, the questionnaires were handed out on roads in the greater Munich area that are well known to be popular with motorcycle riders (for the pleasure of riding). Riders were asked to participate during rests at parking’s or popular spots for having a break. The questionnaires were collected immediately after they had been completed. The survey was done on weekdays with rather good weather conditions.

The Italian questionnaire was translated in Italian by a mother-tongue researcher involved in the integrated safety research group. The questionnaires were distributed personally or by e-mail to friends and handed out in public places (e.g. near schools and petrol stations). Some participants were interviewed; others returned the questionnaire after filling it in autonomously.

Most Dutch questionnaires were handed out on motorcycle events and to friends and acquaintances. The questionnaires were collected by mail or e-mail after they had been completed by the participants.

2.2 Questionnaire
The questionnaires contained personal information about the PTW drivers. This included information about:

- Gender
- Age
- Children
- Stature
- Weight
- PTW make
- PTW type

Secondly, the driving experience was considered. This includes:

- The types of driving licence
- Driven kilometres per year and driving proficiency courses
- Driven trajectories
- Driving circumstances
- Reason for driving a PTW
- Driving style and behaviour
- Offences
- Protection
- Driving with a passenger and/or luggage
- Objects that hinder the driving task
- Secondary tasks
- Amount of accidents
- Experienced dangerous situations

Thirdly, the PTW drivers were asked what support systems they would like to have on their PTW to improve safety. The English questionnaire is shown in the appendix in this report.
3 Results and analysis

The results are discussed, in the sections below, for all three combined countries as well as for each separate country (D, I and NL). The first section (3.1) contains the demographic information concerning various PTW riders. The second section (3.2) contains the results about the driver’s experience. The last section, section (3.3), describes different driver support systems to improve safety and contains information to consider the value of these systems from the driver’s perspective.

3.1 Demographic information

The places in Germany, Italy and the Netherlands where the PTW drivers were located are shown in Figure 1. Most of the German drivers were located in the south of Germany. Seven of them lived just across the border in Austria. The Italian drivers were located in three different places, Florence (73), Bologna (3) and Pistoia (24). The Dutch drivers were spread all across the Netherlands. It is obvious that the total number of correspondents is limited in size and cannot be regarded as being representative for the group PTW drivers in the EU because of the limited amount of countries involved in this study (only GE, I and NL) and also for the concentration of correspondents for Italy and Germany (close to Munich).
3.1.1 Personal PTW driver information

From the total of 261 PTW drivers, 223 (85%) were men and 38 (15%) were women. In Germany 65 were men and 3 were women. In Italy 79 men participated and 21 women. In the Netherlands there were 80 men that participated and 13 women. The total percentage of males and females shows no over or under representation of certain genders when compared to the data given in the MAIDS study (14.4% females and 85.6% males, MAIDS 2004).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Man</th>
<th>Woman</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>65</td>
<td>3</td>
<td>68</td>
</tr>
<tr>
<td>Italy</td>
<td>79</td>
<td>21</td>
<td>100</td>
</tr>
<tr>
<td>Netherlands</td>
<td>80</td>
<td>13</td>
<td>93</td>
</tr>
<tr>
<td>Total</td>
<td>223</td>
<td>38</td>
<td>261</td>
</tr>
</tbody>
</table>

Table 7.1: PTW rider gender

Age

The 223 men had an average age of 36.2 years with a standard deviation of 12.0 and the 38 women were on average 33.6 years old with a standard deviation of 8.5. Of the 261 participants, 100 participants had children.
In Germany the 65 men had an average age of 40.2, in Italy the 79 men were 33.8 years old and in the Netherlands the 80 men were 35.3 years old with a standard deviation of respectively 12.4, 11.8 and 10.9.

In Germany the 3 woman had an average age of 46.3 years, the 21 Italian women were on average 31.3 years old and the 13 Dutch women were on average 34.1 years old. The standard deviations were respectively 2.1, 8.3 and 7.5.

From the German participants, 25 had children. From the Italian participants 27 had children and from the Dutch participants 48 had children.

**Length**

The average length of the 223 men was 180.2 cm with a standard deviation of 7.1 cm. The tallest man was 201 cm and the shortest was 160 cm. The average length of all 38 women was 169.0 cm with a standard deviation of 5.6 cm. The tallest woman was 183 cm and the smallest was 154 cm.

The average length of the 65 men in Germany, 79 men in Italy and the 80 men in the Netherlands was respectively 179.0, 178.0 and 183.4 cm with respectively the following standard deviations: 7.1, 6.1 and 6.9 cm.

The participated 3 German, 21 Italian and 13 Dutch women were on average respectively 172.3, 166.2 and 172.5 cm tall with respectively the following standard deviations 2.5, 5.0 and 4.9 cm.

**Weight**

The average weight of the 223 men was 79.6 kg with a standard deviation of 9.9 kg. The heaviest man was 120 kg and the lightest man was 56 kg. The average weight of the 38 women was 62.0 kg with a standard deviation of 10.2 kg. The heaviest woman was 88 kg and the lightest was 43 kg.

The average weight of the 65 men in Germany, 79 men in Italy and the 80 men in the Netherlands was respectively 82.1, 74.7 and 82.6 kg with respectively the following standard deviations: 10.7, 8.6 and 8.4 kg.

The participated 3 German, 21 Italian and 13 Dutch women had an average weight of respectively 65.7, 56.4 and 69.8 kg with respectively the following standard deviations 6.0, 8.1 and 8.4 kg.

### 3.1.2 PTW make

From all the PTW drivers that have participated in this study, 253 of them had a PTW or scooter. 66 of the 68 German participants had a PTW or scooter, 95 of the 100 Italian and 90 of the 93 Dutch participants had their own PTW or scooter.

The drivers drove PTWs from differing manufacturers, which are shown in Figure 2. It is shown that overall Honda was the most popular brand among the drivers that participated followed by Yamaha and BMW. This varies for the different countries. Most of the German participants drove a BMW followed by Yamaha, Honda and Suzuki. Most of the Italian participants had a Honda, but the same amount of Italian drivers drove a Piaggio.

The amount of different PTW brands per country found by this questionnaire study could be verified by the selling figures of the different brands for these countries. Figure 2 also shows...
PTWs as well as scooters and does not contain any information about the type of PTW. This has therefore been verified in the next subsection.
3.1.3 PTW type

All registered PTWs have been categorized into the following different styles or models. These models were previously defined in the MAIDS study (MAIDS 2004). Some of these styles are in some studies categorized as PTW type L1, or mofas, mopeds and scooters with small engines (smaller than 250cc). Motorcycles, on the other hand are referred to as L3 type PTWs. The categories for this survey are:

- Sport style PTW (L3);
- Sport Touring style PTW (L3);
- Roadster or Conventional Street style PTW (L3);
- Cruiser style PTW (L3);
- Offroad or Enduro style PTW (L3);
- Scooter >250cc style PTW (L3);
- Scooter <250cc or Step-through style PTW (L1)

The PTWs were also divided in different PTW styles in the review of existing European databases study described in deliverable D02. The comparison of the PTW styles together with illustrations is shown in the appendix.

The results of all participants together as well as the different PTW models per country are shown in Figure 3. It is shown that most of the participants drove a sport PTW followed by the roadster. If the scooters are not taken into account, a cruiser seemed to be the least popular PTW. If the scooters are considered, it seemed that only 4% of all the participants that had a PTW had a scooter with an engine size of more than 250cc.

In Germany (D) the most popular PTWs were also the sport PTW, followed by the roadster. The least popular PTW, if the scooters are not taken into account, was also the cruiser with 11% of all the German PTW drivers that had a PTW. If the scooters are taken into account, none of the German participants drove a scooter with an engine size of less than 250cc. The German scooter drivers of scooters with an engine size of less than 250cc were not interviewed. The German participants that drove a scooter with an engine size of more than 250cc were interviewed, but they cover only 2% of the interviewed German driver population.

In the Netherlands (NL) the sport PTW seemed to be the most popular PTW as well, followed by the roadster, but the off-road PTW seemed to be less popular than the cruiser. The interviewed Dutch driver population did not contain any scooter drivers.

When the Italian participants were concerned it is shown that according to the amount of participants that drove a scooter, almost half the Italian participants had a scooter. This should be kept in mind when the driver experience results and the preferred safety systems will be discussed in the next section. Because the average speed of the scooter and the environment where the scooter is used differs with respect to a PTW, this could influence the results of what safety systems the driver would prefer to have on his/her PTW/scooter. This does especially apply for scooters with an engine size of less than 250cc. Therefore, the results of the Italian data will also be considered in more detail where necessary.

If the scooters are not taken into account, it seemed that the sport PTW and the roadster were the most popular PTW types for the Italian participants. The least popular were the tour PTW and the cruiser.

It is obvious that the total number of correspondents is limited in size and cannot be regarded as being representative for the group PTW in the EU. Especially, the percentage of scooter
drivers, as presented in the MAIDS report (MAIDS, 2004), was under represented in this survey. The number of scooter drivers, with engines smaller than 250cc, was 73% for the MAIDS study and only 16% for our study.

Motorcycle type (D, I, NL), n=253
3.2 Driving experience

3.2.1 Driving licenses

The participants owned their PTW license on average for 13.7 years with a standard deviation of 11.2 years. Their average mileage was 6861.4 km per year with a standard deviation of 5870.6 km. This large standard deviation illustrates rather large differences between the yearly mileages for the participants: the minimal reported mileage was 80 km
per year and the highest mileage was 35000 km per year. Forty-five of the participants followed a driving training course in the last year.

The German participants had an average of 18.4 years that they owned their PTW licence with a (large) standard deviation of 13.0 years. The average mileage was 7724.2 km per year with a standard deviation of 4489.0 km per year. The minimal mileage was 800 km per year and the highest mileage was 20000 km per year. 24 of the 68 participants had done a driving training course in the last two years.

The Italian and Dutch participants had their licence on average for 11.9 years and 11.8 years with a standard deviation of 10.1 years and 9.6 years respectively. The average mileage per year driven by the Italian drivers was 5289.0 km with a standard deviation of 5279.2 km. The minimal mileage was 80 km per year and the highest mileage was 35000 km per year. Four of the Italian participants had done a driving training course in the last two years.

The Dutch participants drove on average 7808.1 km per year with a standard deviation of 6994.6 km. The minimal mileage was 500 km per year and the highest mileage was 32000 km per year. Of the Dutch participants, 17 of the participants did a driving training course in the last two years.

3.3 Opinion towards awareness of other traffic w.r.t PTWs

The participants were also asked about their opinion towards the awareness of other traffic with respect to PTW drivers (see Figure 4). Only 21% of the 261 participants answered that they thought that the other traffic is aware of the behaviour of PTW drivers in traffic. A staggering 77% did not think that the other traffic is aware\(^1\) of the PTWs in traffic (2% of the 261 participants did not have an opinion) and 35% of the participants did not think that other traffic is aware of PTWs in traffic because they thought PTWs are not very well visible and are therefore overlooked by other traffic. 25% of the participants had the opinion that other traffic does not properly estimate the speed and vulnerability of the PTW (often because they do not drive a PTW themselves). This means that from the PTW driver’s point of view 60% of the other traffic does not properly pay attention towards PTWs. Even more, 5% of the participants thought that other traffic even hinders or ignores the PTWs on purpose. 3% gave another reason and 9% did not give a reason why they thought that other traffic was not aware of PTWs.

Figure 4 shows that only one fifth of the other road users were aware of motorcyclists. This is even lower when only Germany is considered, where it is only 12%.

The opinion that the PTWs are overlooked by other traffic is in Germany shared by 18% of the participants. One quarter of the Italian drivers shared this opinion while in the Netherlands this was 62%. Of the German drivers 51% thought that the other traffic was not well aware of the motorcyclists because they did not properly estimate the speed and vulnerability of the PTWs. In Italy this was 22% and in the Netherlands this was only 7%. The percentage of participants that gave another reason; did not have a reason or opinion is for all three countries almost the same.

It seemed that 69% of the German and Dutch other traffic does not pay attention towards PTWs, in Italy this is 48%. This could be explained by the fact that PTWs and scooters are typical for the everyday street scene in Italy and therefore answers the expectations of the other traffic.

\(^1\) The thought that the other traffic is not aware of PTWs because the PTWs are overlooked or they did not properly estimate the speed and vulnerability is considered as not paying attention towards PTWs.
Awareness by other road users (D, I, NL)

Awareness by other road users (D)

Awareness by other road users (I)
Figure 4 Awareness of PTWs by other road users
3.4 Driven trajectories

Figure 5 shows the driven trajectories for all participants. The participants drove often on urban and rural roads; they drove sometimes on motorways and hardly ever on unpaved roads. It is also shown that the standard deviation for the motorway trajectory data is larger than the standard deviation for other trajectories. It could therefore be stated that the variation of motorcyclists that hardly ever drove on motorways and motorcyclists that always drove on motorways is larger than for the other trajectories.

When considering the separate countries it becomes clear that the German participants drove more often on rural roads than on urban roads while the Italian participants drove more on urban roads than on rural roads. An explanation could be that almost half the Italian participants drove a scooter, which is specifically designed for driving in urban areas.

The German and Italian participants drove quite often on rural and urban roads: almost twice as often as driving on motorways. This is not the case for the Dutch participants: they drove frequently on motorways.

A repeated measures ANOVA was used to test for significant differences between the three countries. Effects were considered being statistical significantly different with a \( p \leq 0.05 \). This test was firstly performed on motorcycle drivers only (category L3) for all three countries. A second analysis was done for Italy only also considering the L1 type PTWs. The independent variables are the three different countries and the different PTW types, sport, tour, roadster, cruiser, off-road and for Italy also scooters. The dependent measures are the four different trajectories: urban road, rural road, motorway and unpaved road.

In the overall data there were 16 of the 1044 data points missing. These data points were spread over 10 of the 261 participants. For Germany 11 of the 272 data points were missing, spread over 8 of the 68 participants. For Italy 5 of the 400 data points were missing, spread over 2 of the 100 participants. The data points were filled with the average of the total data points per different trajectory.

Results of the Repeated Measures ANOVA for all different countries (no scooters included)

The overall results are shown in Figure 9. The results are connected by a line for reasons of clarity.

Main effects

The main effect of trajectories was significant \[ F(3, 588) = 245.50, p<0.001 \]. The effect of the different trajectories was determined by the Tukey test. This resulted in a highly significant effect \( p<0.001 \) for all trajectories. The participants drove most frequently on urban and rural roads. They drove less frequently on the motorway and almost hardly ever on unpaved roads.

Next to the effect of the different trajectories on the driving frequency on these trajectories, the main effect of the nationality of the driver was also significant \[ F(2, 196) = 13.69, p<0.001 \]. The Dutch motorcycle driver had a higher average driving frequency for all trajectories than the German drivers \( p<0.001 \). The Italian motorcycle drivers had a higher average driving frequency than the German drivers \( p<0.05 \) (Note: the scooters drivers were not included).

Also the effect of the motorcycle type on the driving frequency was significant \[ F(4, 196) = 3.03, p<0.05 \]. The drivers with an off-road motorcycle had a higher average driving frequency than the drivers with a touring motorcycle \( p<0.05 \).
Figure 5 Driven trajectory for all countries together (No scooters)

Figure 6 Driven trajectory per country (No scooters)
In Figure 10 shows the mean driving frequencies of the driven trajectories per country. The interaction between trajectory and country was highly significant \[F(6, 588) = 19.36, p<0.001\]. The Tukey test showed a highly significant effect \[p<0.001\] of the trajectories for Germany. The effect of the trajectories for Italy was for the urban road and the rural road not significant. This means that the Italian participants drove as often on urban roads as on rural roads and less on motorways \[p<0.001\]. The Italian participants drove less on unpaved roads compared to motorways \[p<0.01\], urban roads \[p<0.001\] and rural roads \[p<0.001\]. The Dutch participants drove as often on urban roads as on rural roads and motorways. They drove hardly ever on unpaved roads compared to the other three trajectories \[p<0.001\].

When the countries are compared to each other, the German participants drove more often on urban roads than the Italian and Dutch participants \[p<0.001\]. The Dutch participants drove more often on rural roads than the German participants \[p<0.001\]. The Dutch participants drove also more often on motorways than the German and Italian participants \[p<0.001\]. The participants from the different countries drove as often on unpaved roads.

In Figure 11 the trajectories per PTW type are shown. The 2-way interaction between trajectory and PTW type was significant \[F(12,564) = 2.83, p<0.001\]. The participants with a sport PTW drove most often on rural roads. A bit less often they drove on urban roads \[p<0.01\]. They drove less often (sometimes) on motorways than on rural or urban roads \[p<0.001\]. The least often (hardly ever) they drove on unpaved roads compared to the frequency they drove on urban roads, rural roads and motorways \[p<0.001\].

The participants driving tour PTWs drove as often on urban roads as on rural roads. There was no significant difference for driving on a motorway compared to driving on an urban road. There was a significant difference found for driving on the motorway compared to
driving on a rural road. This means that they drove a bit more often on rural roads compared to motorways (sometimes) \[p<0.001\]. They hardly drove on unpaved roads \[p<0.001\].

The participants driving roadsters drove as often on urban roads as on rural roads. They drove less on motorways (sometimes) compared to driving on urban and rural roads \[p<0.001\]. The least they drove on unpaved roads (hardly ever) compared to driving on urban roads, rural roads and motorways \[p<0.001\].

The participants with a cruiser drove also as often on urban roads as on rural roads. They drove less on motorways (sometimes) compared to urban roads \[p<0.05\] and rural roads \[p<0.001\]. The least they drove on unpaved roads compared to urban and rural roads \[p<0.001\]. The difference between the driving frequency for motorways and unpaved roads was not significant.

The 3-way interaction between the driven trajectories and the different countries and PTW types is shown in Figure 8. The effect of the different countries and PTW types on the driven trajectories was borderline significant \[F(24, 288) = 1.328, p<0.05\].
Results of the Repeated Measures ANOVA for Italy

Because the data from the Italian participants also contained scooter drivers, a second analysis including scooters was conducted. This analysis was determined to verify if the scooter drivers indeed drove more often on urban roads with respect to rural roads and therefore caused a higher driving frequency for urban roads in Figure 10.

Main effect

The main effect of the trajectories on the driving frequency was significant \( F(3,279) = 82.01, p<0.001 \). A Tukey test showed a high significant effect for the different trajectories on the driving frequency \( p<0.001 \). The Italian participants often drove on urban roads (4.45), a bit less on rural roads (3.25). They sometimes/hardly ever drove on motorways (1.34) and they hardly ever drove on unpaved roads (0.82). It was considered that the main effect of the PTW types on the driving frequency was also significant \( F(6,93) = 4.48, p<0.05 \). The participants that drove the off-road PTWs (mean frequency of 3.00 = quite often) had a higher driving frequency for the total of different trajectories than the participants that drove a scooter with an engine size of less than 250 cc (mean frequency of 3.00 = sometimes).

2-way effect

The 2-way interaction was also significant \( F(18,279) = 5.22, p<0.001 \) and is shown in Figure 12. It is shown that the participants that had an off-road PTW on average drove more on all different trajectories than the participants with other PTW types. The participants that had a scooter with an engine size of less than 250 cc drove significantly more on urban roads than on rural roads.

Summary

The overall conclusion about the driven road types is that the participants of all the three different countries drove \textit{often} on rural roads, \textit{quite often} on urban roads, \textit{sometimes} on motorways and \textit{hardly ever} on unpaved roads. The German participants drove less frequently on urban roads compared to the other two countries and the Dutch participants drove more frequently on motorways compared to the other two countries.
Figure 9 Driven trajectory for all countries together (No scooters)

Figure 10 Driven trajectory per country (No scooters)
Figure 11 Driven trajectory per PTW type
Figure 12 Driven trajectories for different Italian PTW types

3.5 Circumstances

The different circumstances where the participants drove are shown in Figure 13. These data contain all participants. The participants seemed to drive their PTW very often in fair weather and during daytime. They seemed to drive quite often in queued traffic and during twilight and sometimes in the rain and during night time. They hardly ever seemed to drive in snow/sleet conditions. To examine if the frequencies of driving under different circumstances was significant, an ANOVA was conducted.

Independent variables and dependent measures

The independent variables in the repeated measures analysis of variance are the three different countries and the different PTW types, sport, tour, roadster, cruiser, off-road and for Italy also scooters. The dependent measures are the seven different circumstances: fair weather, rain, snow, daytime, night-time, twilight and queued traffic.

Missing data

In the overall data there were 25 of the 1827 data points missing. These data points were spread over 17 of the 261 participants. For Germany 7 of the 476 data points were missing, spread over 2 of the 68 participants. For Italy 16 of the 700 data points were missing, spread over 4 of the 100 participants. For the Netherlands 2 of the 651 data points were missing, spread over 2 of the 93 participants. The data points were filled by the average of the total data points per different circumstance.
Results of the Repeated Measures ANOVA for all different countries (no scooters included)

For the analysis, the data were divided. The data for all countries was first analyzed without scooter drivers, because these were only answered for in the Italian interview study. Secondly, the Italian data were analyzed separately including scooters.

Main effect

The ANOVA showed a significant main effect for the independent variables country, PTW type and the circumstances, respectively [F(2,196) = 21.28, p<0.001], [F(4,196) = 4.93, p<0.001] and [F(6,1176) = 199.67, p<0.001].

The Italian participants reported a higher average driving frequency (3.54) for all circumstances than the German participants (2.56) [p<0.001] and the Dutch participants (3.17) [p<0.05]. The Dutch participants had a higher average driving frequency than the German participants [p<0.001]. This suggest that the PTW is a more often used way of transport in Italy than in Germany or the Netherlands and a more often used way of transport in the Netherlands compared to Germany.

The main effect of the different PTW types on the driving frequencies was analyzed and this showed that the participants that drive an off-road PTW had the highest average driving frequency for all circumstances together (3.45) compared to the sport PTW (2.78) [p<0.001], the roadster drivers (2.88) [p<0.01] and the cruiser drivers (3.05) [p<0.05].

The main effect of the different circumstances is shown in Figure 14. The difference in driving frequency between driving in fair weather or during daytime (often) with respect to driving in twilight or queued traffic (quite often), in rainy weather or during night (sometimes) or snow (hardly ever) was highly significant according to the conducted Tukey test [p<0.001]. The same significant effect was found for driving in twilight or queued traffic (quite often) compared to the other concerned circumstances [p<0.001]. Also driving in rain (sometimes) was significantly different from driving in fair weather (often), in snow (hardly ever), during daytime (often), in twilight (sometimes) and in queued traffic (sometimes) [p<0.001] and during night (sometimes) [p<0.05].

2-way and 3-way interaction

The 2-way interactions between country and PTW type, between circumstances and country and between circumstances and PTW type showed also a high significant effect, respectively [F(8,196) = 4.15, p<0.001], [F(12,1176) = 7.81, p<0.001] and [F(24,1176) = 2.91, p<0.001]. The 2-way interactions were analyzed and provided the same results that were drawn in the main effects analysis.

The 3-way interaction effect between circumstances, country and PTW type on the frequency rate was significant [F(48,1176) = 1.59, p<0.01].
Figure 13 Circumstances
Results of the Repeated Measures ANOVA for Italy

The analyses on all three countries only include L3 type PTWs (motorcycles). The Italian data also includes L1 type (scooters).

Main effect

The PTW types had a significant effect on driving frequency for all circumstances \( [F(6,93) = 2.88, p<0.05] \). The frequency was lower for drivers with a sport PTW than drivers with an off-road PTW.

The different circumstances that were driven had also a significant effect on the driving frequencies of these circumstances. The difference in driving frequency between driving in fair weather or during daytime (always) with respect to driving in night-time or queued traffic (quite often), in rainy weather (quite often/sometimes) or snow (hardly ever) was highly significant according to the conducted Tukey test \( [p<0.001] \). The same significant effect was found for driving in night-time or queued traffic (quite often) compared to the other concerned circumstances \( [p<0.001] \). Also driving in the rain (sometimes) was significantly different from driving in fair weather (always), in snow (hardly ever), during daytime (always), in twilight (often) and during night (sometimes) \( [p<0.001] \), no significant was found for queued traffic (quite often).

The 2-way interaction was also significant \( [F(36,558) = 1.50, p<0.05] \).
Summary

The overall conclusion about the driving circumstances is that the participants of all three different countries (no scooters included) drove always in fair weather and during daytime, often during twilight and in queued traffic, quite often during night and in the rain and hardly ever in the snow. The Italian participants drove more frequently during night and twilight compared to the other two countries and the German participants drove less frequently (hardly ever) in rain and snow compared to the other two countries.

3.6 Reason for driving a PTW

The participants were asked what their main purpose was of driving a PTW. This was divided into two main reasons, for fun and economical. Driving a PTW for fun included three sub-reasons: PTW holiday, weekend trips and for hobby sports. Driving a PTW for economical reasons included the following three sub-reasons: less fuel consumptions, less traffic time and driving as part of work.

It was hypothesized that drivers that use the PTW for fun drive not very often and only drive in periods when the traffic density is low. This could have an influence on the risk of having an accident; it could then be assumed that these types of drivers have a lower risk on having an accident than drivers that drive for economical reasons. For drivers that have their PTW for weekend trips, it could also be assumed that they have a higher risk on having an accident than drivers that only use their PTW for holiday trips. The risk could be assumed to increase with the reason to drive a PTW. However, when we would include the amount of kilometres driven and driving experience, this could work out the other way around: assuming a lower risk of having accidents.

Some of the participants gave more than one answer for the reason to drive a PTW. In these circumstances, the answer with the assumed highest risk of having an accident was considered only.

Independent variables and dependent measures

The independent variables in the factorial analysis of variance were the different PTW types: sport, tour, roadster, cruiser, off-road and for Italy also scooters.

To verify the hypothesis that the reason for driving a PTW is related to accident risk, the following variables in relation to the reason to drive a PTW were considered as well: the average amount of kilometres that the drivers drove in one year; the trajectories that were driven by the drivers and the driving circumstances.

The dependent measures are the six different reasons for driving a PTW: PTW holiday, weekend trips, hobby/sports, fuel consumption, traffic time and work.
Missing data
In the overall data there were 2 of the 261 data points missing. These data points were spread over 2 of the 261 participants. For Germany 1 of the 68 data points was missing, and thus 1 of the 68 participants. For Italy 1 of the 100 data points was missing and thus 1 of the 100 participants.

The average amount of kilometres that the drivers drove in one year missed 22 of the 261 data points. The data points were filled by the average of the total data points per different circumstance.

Results of the Factorial ANOVA for all different countries (no scooters included)
The results of the reasons that were given by the participants were verified for the total data without the scooters.

Next to that it was assumed that the reason for driving a PTW is related to accident risk. To verify this, the average amount of kilometres that the drivers drove in one year was verified and so were the trajectories that are driven by the drivers and the circumstances they have driven in.

Main effect
The reason for driving a PTW seemed to be related to the different PTWs types, i.e. the sport PTWs, tour PTWs, roadsters, cruisers and off-road PTWs $[F(4,196) = 3.16, p<0.05]$. However, the Tukey test did not show a significant difference between the reason for driving a PTW and the different PTW types. This means that all different PTW drivers had on average the same reason for driving a PTW.

For the data where the scooter drivers were not taken into account, the analysis showed that the reason to drive a PTW differed per country $[F(2,196) = 19.83, p<0.001]$. The results are shown in Figure 17. The Tukey test showed that the German participants on average drove a PTW for fun (weekend trips and/or hobby/sport). This differed significantly from the reasons for the Italian and the Dutch PTW drivers, respectively $[p<0.01]$ and $[p<0.001]$. The Italian, on average, drove a PTW for fun (hobby/sport). The reason for driving a PTW for the Dutch PTW drivers seemed to be more for economical reasons. The reason for driving a PTW was differed significantly between the Italian and Dutch PTW drivers.

2-way interaction
The 2-way interaction between PTW type and the different countries gave also a significant effect on the reason for driving a PTW $[F(8,196) = 3.48, p<0.001]$. It turned out that the reason for driving a touring PTW differed for the Dutch and the German PTW drivers $[p<0.001]$. The Dutch participants that drove a touring PTW used their PTW for economical reasons, the German participants drove for fun.

Reason for driving a PTW considered for data with scooter drivers included
The total data was also considered for the data including scooter drivers to see if the reason for driving a PTW would be different. This was analyzed by a one-way ANOVA. First for the effect of the different PTW types on the reason to drive a PTW, secondly on the effect of the different countries on the reason for driving a PTW was analyzed.
Main effect

When the data with the scooters included was considered, it was found that there was a main effect for the different PTW types \[ F(6,254) = 13.64, p<0.001 \]. The results are shown in Figure 18.

The drivers of scooters with an engine size less than 250 cc gave on average as reason for driving this scooter that they use it for economical reasons to reduce travel time. This reason was significantly different from the drivers that were driving sport PTWs, tour PTWs, roadsters, cruisers and off-road PTWs \[ p<0.001 \]. Their reason was on average that they drove a PTW for fun, as a hobby or sport.

The drivers that drove a scooter with an engine size larger than 250 cc gave on average also an economical reason which seems to be closer to the reason of less fuel consumption than less travel time. The difference between the reasons given by the scooter drivers of scooters with engine sizes less and larger than 250 cc is not significant. The reason that is given by the scooter drivers of larger than 250 cc is significantly different from the sport PTW drivers \[ p<0.05 \], the roadster driver \[ p<0.05 \] and the cruiser driver \[ p<0.01 \].

The effect of the different countries on the reason for driving a PTW was analyzed. This analysis also showed that the reason for driving a PTW differs per country \[ F(2,258) = 25.66, p<0.001 \]. The results are shown in Figure 19. The Tukey test showed different reason for driving a PTW for the Italian PTW drivers. The average reason of driving a PTW changed from driving for fun to an economical reason. This was significantly different from the German reason for driving a PTW, namely (for fun) \[ p<0.001 \] and the Dutch reason (between for fun and economical reasons) \[ p<0.05 \]. The reason for driving a PTW for the German participants was also significantly different compared to the Dutch reason for driving a PTW \[ p<0.001 \].

Relation between the purpose of driving a PTW and accident risk

Reason for driving a PTW in relation to the average amount of kilometres per year

To verify if the reason for driving a PTW was related to the average amount of driven kilometres per year, a one-way ANOVA of the total data set was conducted. The ANOVA showed that the average amount of driven kilometres per year differed significantly for the different reasons to drive a PTW \[ F(5,255) = 4.00, p<0.01 \]. The results are shown in Figure 20. The drivers that drove a PTW for weekend trips had a lower average amount of driven kilometres per year (4851 km/y) than drivers that drove a PTW for their hobby/sport (7673 km/y) \[ p<0.05 \] and for work (11995 km/y) \[ p<0.01 \]. The drivers that drove for less travel time had also a lower average amount of kilometres than drivers that drove for their work \[ p<0.05 \].
Figure 15 Reason for driving a motorcycle
Figure 16 Reason for driving a PTW per PTW type, no scooter drivers

Figure 17 Reason for driving a PTW per country, no scooter drivers
Figure 18 Reason for driving a PTW per PTW type

Figure 19 Reason for driving a PTW per country with scooters
Reason for driving a PTW in relation to the driven trajectories

To verify if the reason for driving a PTW was related to the driven trajectories, a repeated measures ANOVA of the total data set was conducted. The ANOVA turned out that the average of all trajectories differed significantly for the different reasons to drive a PTW \[F(3,765) = 227.92, p<0.001\].

To verify the relation between the driven trajectories and the reason for driving a PTW, the 2-way interaction was considered. This effect was also significant \[F(15,765) = 6.93, p<0.001\]. The results are shown in Figure 21. The drivers that drove a PTW for PTW holidays drove less on urban roads than drivers that drove for the economical reason of less travel time \[p<0.01\].

Reason for driving a PTW in relation to the driven circumstances

To verify if the reason for driving a PTW was related to the driven circumstances, a repeated measures ANOVA of the total data set was conducted. The ANOVA turned out that the average of all circumstances differed significantly for the different reasons to drive a PTW \[F(6,1530) = 231.18, p<0.001\]. The total frequency of driven circumstances seemed to be different too for the different reason of driving \[F(5,255) = 9.50, p<0.001\]. The Tukey test showed that all the three different fun reasons to drive a PTW, PTW holiday, weekend trip and hobby/sport, differ significantly from the economical reasons, less travel time and work. For the PTW holiday reason with respect to less travel time and work \[p<0.01\] and \[p<0.01\]. For the PTW weekend trip reason with respect to less travel time and work \[p<0.001\] and \[p<0.001\]. For hobby/sport reason with respect to less travel time and work \[p<0.001\] and \[p<0.001\]. The results are shown in Figure 22. To verify the relation between the driven circumstances and the reason for driving a PTW, the 2-way interaction was considered. This effect was also significant \[F(30,1530) = 3.13, p<0.001\]. However, the conclusion that could be drawn from the Tukey test results is the same as was concluded in the description about the main effects, described previously.

Summary

The overall conclusion about the purpose of driving a PTW is that the German participants drove mainly for fun. This was concluded from the ANOVA for all PTW types excluding the scooters. For the Dutch participants it seemed that the participants that drove a sport PTW, roadster, a cruiser or an off-road PTW, drove mainly for fun. The participants that had a touring PTW drove mainly for economical reasons. In this analysis, the scooter drivers were also not included. When the scooter drivers were included it seemed that the Italian drivers that drove a sport PTW, touring PTW, roadster, a cruiser or an off-road PTW, drove mainly for fun. The participants that had a scooter with an engine size of less than 250cc or a scooter with an engine size of more than 250cc drove mainly for economical reasons.

Finally, there was no clear relation found between the reason for driving a PTW and the amount of driven kilometres, the different road types that were driven and the different circumstances.
Figure 20 Reason of driving related to average amount of km per year

Figure 21 Relation between reason for driving and driven trajectory
3.7 Driving style

The participants were asked to rate their driving style by a number between the 1 and 7. The lowest rate 1 means a calm driving style and the highest rate 7 means a reckless (more assertive) driving style. From the overall picture for all data, shown on top in Figure 23, it seems that there is a Gaussian distribution for a calm driving style towards a reckless driving style. This was analyzed with an ANOVA.

Independent variables and dependent measures

The independent variables in the factorial analysis of variance are the different PTW types: sport, tour, roadster, cruiser, off-road and for Italy also scooters. The one-way ANOVA was also conducted for the different countries for the data with the scooter drivers included. The dependent measures are the different driving styles from calm (#1) to reckless (#7).

Missing data

In the overall data there were 4 of the 261 data points missing which means 4 of the 261 participants. For Germany 1 of the 68 data points was missing, and thus 1 of the 68 participants. For Italy 1 of the 100 data points was missing and thus 1 of the 100 participants. For the Dutch participants 2 of the 93 data points were missing and thus 2 of the 93 participants. The data points were filled by the average of the total data points.

Results of the Factorial ANOVA for all different countries (no scooters included)

The driving style was considered for all PTW type L3 (thus excluding scooters, type L1).
Main effect

The factorial ANOVA on driving style for the different countries and bike types (excl. scooters) showed a main effect of the different countries and bike types on the driving style, respectively $[F(2,196) = 6.52, p<0.01]$ and $[F(4,196) = 4.49, p<0.01]$. It was considered that the Italian drivers had a higher average rate for the driving style than the German $[p<0.001]$ and Dutch $[0.001]$ drivers. This indicates that the Italian PTW drivers seem to drive more recklessly than the German and Dutch drivers. The results are shown in Figure 24.

The average rate for the driving style that was given by all sport PTW drivers (4.10) was higher than the tour PTW drivers (3.30) $[p<0.05]$ and the cruiser drivers (2.71) $[p<0.001]$. The roadster drivers (3.52) and the off-road drivers (3.58) also had a higher average rate for the driving style than the cruiser drivers, respectively $[p<0.05]$ and $[p<0.01]$. This means that the sport PTW drivers seem to drive more recklessly than the tour PTW drivers and the cruiser drivers. Also the roadster drivers and off-road PTW drivers seem to drive more recklessly than the cruiser drivers. The results are shown in Figure 25.

The 2-way interaction was not significant.

Summary

The analysis for all data excluding the scooter drivers showed that the German (3.2) and Dutch (3.0) participants drove less recklessly than the Italian participants (4.2).

It was also shown that the participants that drove a sport PTW (4.1) drove more recklessly than the participants that drove a touring PTW (3.3) or a cruiser (2.7). The participants that drove a roadster (3.5) of an off-road PTW (3.6) drove also more recklessly than participants with a cruiser (2.7).

The one-way ANOVA with the scooter drivers included showed that the participants that had sport PTW (3.9), an off-road PTW (4.0), a scooter with an engine size of less than 250cc (3.7) or a scooter with an engine size of more than 250cc (4.1) drove more recklessly than participants that had a cruiser (2.5).

Driving behaviour and offences

Next to the driving style, also the driving behaviour was asked to get an insight in the driving behaviour from the perspective of the drivers. The participants had to indicate what their main driving behaviour was in traffic. They could choose from: social; far-away/no attention; casual/careless; assertive/sporty; impatient/hasty; quickly irritated and thoughtless. The results are shown in Figure 26. These results just provide an indication of the driving behaviour and were not further analyzed.

The number of offences was also asked. The results are shown in Figure 27. It seems that the Dutch had much more speeding tickets for driving less than 10 km/h too fast than for driving more than 10 km/h too fast compared to the German and Italian drivers. This is probably because of the much higher fine the Dutch receive when they drive more than 10 km/h too fast.
Figure 23 Driving style of participants
Figure 24 Driving style per country

Figure 25 Driving style per bike type
Driving behaviour (D, I, NL)

Figure 26 Driving behaviour of the participants
Figure 27 Offences of the participants
3.8 Protection of the participants

The participants were asked if they sometimes drive without one of the following protection: Helmet; motor jacket; motor trousers; motor suit; motor gloves; boots; earplugs; body protector; back protector; knee pads and kidney belt. This was analyzed for the different countries and for the different PTW types. The results of the different protection that are sometimes not worn are shown in Figure 28 for the complete data set and for the separate countries.

Independent variables and dependent measures

The independent variables in the factorial analysis of variance are the different PTW types: sport, tour, roadster, cruiser, off-road and the three countries.

The dependent measures are the twelve different types of protection: Always all protection; helmet; motor jacket; motor trousers; motor suit; motor gloves; boots; earplugs; body protector; back protector; knee pads and kidney belt.

Results (no scooters included)

Main effect

According to the repeated measures ANOVA, there was a main effect of the different countries and the type of protection on the percentage of drivers that sometimes drive without some of the earlier specified protection, respectively $[F(2,196) = 10.44, p<0.001]$ and $[F(11,2156) = 29.97, p<0.001]$. The results are shown in Figure 29. The Tukey test showed that the Italian participants drove more without some type of protection than the German $[p<0.001]$ and Dutch $[p<0.001]$ drivers.

It was also shown that from all the drivers, the most drivers drove with a helmet and after that a motor jacket and motor gloves, compared to all other protection wear. They also wore more often boots and a motor suit than motor trousers, earplugs, body protector, knee pads and kidney belt. The results are shown in Figure 30.

2-way interaction

There were also significant differences for the 2-way interaction protection type and country and the 2-way interaction protection type and bike type, respectively $[F(22,2156) = 6.13, p<0.001]$ and $[F(44,2156) = 1.38, p<0.05]$. The Tukey test showed for the 2-way interaction protection type and country that the German participants drove more often with a kidney belt than the Italian and Dutch participants.

The results for the 2-way interaction protection type and bike type did not differ from the results found for the main effect.

Summary

It could be concluded that the protection that is most often worn is of the following order:

1. Helmet
2. Motor jacket, motor gloves
3. Boots, motor suit
4. Motor trousers, earplugs, body protector, knee pads and kidney belt

Overall, the Italian participants seemed to wear less protection compared to the German and Dutch participants.
Figure 28 The percentage drivers that sometimes drive without the specified protection
Figure 29 Protection per country

Figure 30 Type of protection
3.9 Desired systems to improve safety

The different systems that could be or are already developed to support the PTW driver to increase the safety are divided into three categories:

- **Advanced Handling & Protection Systems (AHPS)**
  - **ABS**: A system that prevents the wheels to lock when braking
  - **TCS**: A system that prevents skidding when accelerating too fast (in a corner)
  - **ESP**: A system that prevents the PTW becoming unstable when braking hard combined with a steering manoeuvre
  - **CDC**: A system that automatically adapts the suspension to the type of road
  - **RPS**: A system that keeps you on the PTW during an accident while offering the right protection
  - **PMS**: A system that minimizes the pitch when braking

- **Collision Warning Systems (CWS)**
  - **FA**: A system that provides a warning when you are too close to lead vehicles
  - **AFA**: A system that provides a warning when you are too close to lead vehicles and intervenes automatically
  - **LDW**: A system that provides a warning signal when you are unintentional departing the lane
  - **OWS**: A system that provides a warning when there is someone next to you (overtaking)
  - **TLSS**: A system that provides support when driving between the 2 lanes of queued traffic

- **Automatic Driving Task Support (ADTS)**
  - **CC**: A system that maintains a constant speed
  - **ACC**: A system that maintains a constant speed and keeps a certain distance with respect to a lead vehicle by decelerating automatically
  - **Hfree**: Hands free mobile phone
  - **AGB**: Automatic gearbox
  - **GPS**: Navigation system
  - **ND**: Enhanced vision display - A display that improves the view by night, fog and/or rain

![Figure 31 Systems to support the driver in the different areas](image-url)
The participants were asked what type of system they would like to have on their PTW and what they would like to spend on it to a maximum of € 2000,-. They could choose from the following values:

- 1 = no system
- 2 = € 0
- 3 = € 0 - € 100
- 4 = € 100 - € 500
- 5 = € 500 - € 1000
- 6 = € 1000 - € 2000

### 3.9.1 Automatic Handling & Protection Systems

The results of the AHPS for the whole dataset and for the separate countries are shown in Figure 32. These results have been analyzed first for all countries excluding scooter drivers, secondly, for Italy separately, including scooter drivers.

**Independent variables and dependent measures**

The independent variables in the repeated measures analysis of variance are the different PTW types: sport, tour, roadster, cruiser, offroad and for Italy also scooters and the three countries. A one-way ANOVA was also conducted for the data with the scooter drivers included.

The dependent measures are the six different types AHPS.

**Results of the dataset without the scooter drivers**

With an ANOVA it was concluded that the PTW type had an influence on the drivers’ amount of interest in the different AHPS \[F(4,196) = 2.50, p<0.05\]. Also the different AHPS systems had an influence on the amount of interest in these systems \[F(5,980) = 15.28, p<0.001\]. The results are shown in Figure 33 and Figure 34.

The Tukey test determined that the sport PTW drivers were least interested in the different types of AHPS compared to tour PTW drivers and roadster drivers, both \[p<0.05\].

When the influence of the different AHPS on the amount of interest in these systems was considered, it turned out that the participants were most interested in ABS on their PTW with respect to the other systems \(3.32 \text{ between } €0 - €100 \text{ and } €100 - €500\) \[p<0.001\]. Also ESP \(2.71 = €0 - €100\) seems to be a system that the participants would like to have, more than TCS \(2.17 = €0\) \[p<0.01\], RPS \(2.10 = €0\) \[p<0.01\] or PMS \(2.09 = €0\) \[p<0.001\]. The CDC \(2.36 \text{ between } €0 \text{ and } €0 - €100\) seemed to be more popular than the PMS \[p<0.01\].

**Results of the dataset for the Italian participants**

The results of the amount of interest in the type of AHPS by the Italian participants did not differ much from the results of the dataset without the scooter drivers. Therefore one could say that the amount of interest in AHPS by the scooter drivers was almost the same as that from the PTW drivers.
3.9.2 Collision Warning Systems

The results of the CWS for the whole dataset and for the separate countries are shown in Figure 35. These results have been analyzed for the dataset with the scooter drivers and for the Italian dataset with the scooter drivers.

Independent variables and dependent measures

The independent variables in the repeated measures analysis of variance are the different PTW types: sport, tour, roadster, cruiser, off-road and for Italy also scooters and the three countries. A one-way ANOVA was also conducted for the data with the scooter drivers included.

The dependent measures are the five different types CWS.

Results of the dataset without the scooter drivers

With the ANOVA it was concluded that the different CWS systems had an influence on the amount of interest in these systems [F(4,784) = 12.53, p<0.001]. The results are shown in Figure 36. The Tukey test showed that the participants were on average more interested in the OWS (1.74 = €0) and the TLSS (1.78 = €0) on their PTW than the FA (1.38 = do not want the system) [p<0.001], AFA (1.21 = do not want the system) [p<0.001] and the LDW (1.37 = do not want the system) [p<0.001].

The 2-way interaction of the relation between the CWS and the three different countries was also significant [F(8, 784) = 3.64, p<0.001]. The Tukey test showed that the Dutch participants seemed to be more interested in TLSS than the German and Italian participants, respectively [p<0.01] and [p=0.06] (marginal significant).

Results of the dataset for the Italian participants

The ANOVA for the dataset for the Italian participants with the scooter drivers included, only showed that the Italian drivers on average wanted to have an OWS for € 0,- compared to the AFA (do not want the system) that they do not want to have [p<0.001]. The amount of interest in the LDW (1.43 = between no system and € 0) was higher than the AFA [p<0.01].

3.9.3 Advanced Driving Task Support

The results of the ADTS for the whole dataset and for the separate countries are shown in Figure 37. These results have been analyzed for the dataset with the scooter drivers and for the Italian dataset with the scooter drivers.

Independent variables and dependent measures

The independent variables in the factorial analysis of variance are the different PTW types: sport, tour, roadster, cruiser, off-road and for Italy also scooters and the three countries. A one-way ANOVA was also conducted for the data with the scooter drivers included.

The dependent measures are the six different types ADTS.
Results of the dataset without the scooter drivers

With the ANOVA it was concluded that the different AHPS systems had an influence on the amount of interest in these systems \( F(5, 980) = 31.28, p<0.001 \). The results are shown in Figure 38. The Tukey test determined that the GPS (2.41 = € 0 - € 100) en ND (2.34 = € 0 - € 100) are wanted by the participants \( p<0.001 \). The Automatic gearbox is not wanted (1.19 = no) compared to CC \( p<0.05 \), Hands free phone \( p<0.001 \), GPS \( p<0.001 \) and ND \( p<0.001 \).

The 2-way interaction of the relation between the ADTS and the three different countries was also significant \( F(10, 980) = 2.89, p<0.01 \). It turned out that the Italian participants were more interested in having a ND than the German participants \( p<0.001 \) and the Dutch participants \( p<0.05 \).

Results of the dataset for the Italian participants

The results of the amount of interest in the type of ADTS by the Italian participants did not differ much from the results of the dataset without the scooter drivers. Therefore one could say that the amount of interest in ADTS by the scooter drivers was almost the same as that from the PTW drivers.

Summary

The outcome of the questionnaires referring to the desired systems is summarized in the following table.

<table>
<thead>
<tr>
<th>Mean price</th>
<th>Driver (ADTS)</th>
<th>PTW (AHPS)</th>
<th>Environment (CWS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>€100-€500</td>
<td>1. ND, GPS</td>
<td>1. ABS</td>
<td>1. OWS, TLSS</td>
</tr>
<tr>
<td>€0-€100</td>
<td>2. Hfree</td>
<td>2. ESP</td>
<td>2. FA, AFA, LDW</td>
</tr>
<tr>
<td>€0-€100</td>
<td>3. CC, ACC, AGB</td>
<td>3. CDC</td>
<td></td>
</tr>
<tr>
<td>€0</td>
<td></td>
<td>4. TCS, RPS, PMS</td>
<td></td>
</tr>
<tr>
<td>No system</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The PTW drivers were most interested in ABS and ESP for AHPS and enhanced vision/night vision display and a navigation system for ADTS. It also seemed that the Italian drivers were more interested in the enhanced vision/night vision display than the other two countries. This could be related to the circumstances that the participants drove in. The Italian drove more during night and twilight than German and Dutch participants.

The Dutch participants were more interested in TLSS than the participants of the other two countries. This could perhaps be related to the reason for driving a PTW. The Dutch participants seemed to drive more for economical reasons than the German drivers. Therefore, the Dutch participants will perhaps drive more frequently in busy traffic.
Figure 32 Values of AHPS
Figure 33 Value of AHPS for the driver related to different PTW types

Figure 34 Value of the different AHPS for the driver
Figure 35 Value of CWS
Figure 36 Value of the different CWS for the driver
Value of Automatic Driving Task Support for the driver (D, I, NL)

Figure 37 Value of ADTS
Figure 38 Value of the different ADTS for the driver

Figure 39 Value of the different ADTS for the driver per country
4 UK User Information Data

TRL has collected data to explore and quantify the interacting influences which determine motorcyclist accident (and casualty) liabilities. This data has been related to existing data sources to investigate the trends in motorcycling accidents to identify how rider characteristics relate to accident risk. The important aspects for the PISa project are summarised here; a full analysis and detailed methodology is reported by Sexton et al. (2004).

4.1 UK Survey methodology

User information data was collected using a similar survey to that of the European survey discussed in Sections 2 and 3 of this report. However, information relating to acceptance was omitted in favour of information relating to accident involvement. This approach allowed the relationship between accident (or casualty) risk and variables such as annual mileage, age, experience, journey type, training, personal characteristics of the riders, and the self-reported behaviours and attitudes of the riders to be explored. In an approach similar to that of the European study, the questionnaires included basic data about the rider’s age, sex, socio-economic status, and car driving experience, the questionnaire asked about riding experience, accidents (including minor spills and more serious accidents), whether the rider was to blame, and a number of ‘psychological’ measures relating to the rider’s behaviour and attitudes.

The questionnaires were sent to a large, random sample, of 30,000 current motorcyclists who were registered as, private-owner, motorcycle keepers in the UK. The survey achieved an 11,360 (40%) response rate. Given the high response rate and random sampling, this survey provides a good representation of the UK PTW user population.

Since the study was focused on linking PTW user information with accident risk, the questionnaire included questions to identify riders who had been involved in accidents including damage-only. The questionnaire was designed to identify variables that could be measured using self-reported questionnaire scales.

The survey included questions on the rider’s experience consisting mainly of descriptive variables such as:

- Whether or not the rider had ridden in the last year,
- An estimate of the mileage ridden on public roads in the last 12 months.
- The engine size of bike most often ridden on public roads split by summer and winter use,
- How often a motorbike had been ridden on public roads by road type and journey purpose – also split by summer and winter,
- The number of licence endorsement points accumulated whilst riding a motorcycle

Information was also requested about road accidents and ‘near misses’ while riding a motorcycle. For those with recent accident history were asked to detail the accident including:

- An indication of ‘what happened first’ in the accident(s),
• Whether or not the accident(s) was a minor spill or a low speed manoeuvring accident,
• The road type and weather and conditions at the time of the accident(s),
• The severity of the injuries sustained by respondents and other road users,
• The type of motorbike being ridden at the time of the accident(s),
• The extent to which respondent felt to blame for the accident(s).

Further questions were asked which related to rider behaviour and motivation, using a ‘Motorcycle Rider Behaviour Questionnaire’ (MRBQ) to rate how often (on a 6-point scale from ‘never’ to ‘nearly all the time’) PTW riders engaged in certain behaviours while riding a motorbike, and was based on the Driver Behaviour Questionnaire (DBQ) developed at Manchester University (Reason et al., 1990). A further Motorcycle Rider Motivation Questionnaire (MRMQ) was designed to assess the motivations of motorbike riders, and was based on the work of Schulz and colleagues (e.g. Schulz et al., 1991). This part of the questionnaire required respondents to rate on a 5-point scale, how strongly they agreed or disagreed with a number of statements about motorcycling. Also included were items relating to the wearing of safety equipment, accident causes, riding skills, accident involvement with other riders and a motorcyclists ‘riding style’ scale.

Respondents were asked about the causes of accidents involving motorbikes by rating how much they agreed or disagreed with a number of statements such as ‘accidents involving motorbikes are often caused by motorcyclist going too fast’, or by ‘drivers not noticing motorcyclists’.

Respondents were also asked to assess how much better or worse they consider themselves compared to other motorcycle riders in terms of a number of riding skills such as ‘controlling the motorbike’, ‘spotting hazards’ and ‘anticipating what other road users are going to do’.

Riding style scale was assessed through respondents rating their own riding style on twelve, 7-point semantic differential scales anchored at the ends – for example ‘attentive – inattentive’, selfish – considerate’ and ‘nervous – confident’.

4.2 Rider Characteristics

In the questionnaire, respondents were asked questions about themselves, their motorbike(s) and their biking habits. Space does not allow a complete tabulation of the extensive data, but the following paragraphs give an indication of the key characteristics of the sample.

4.2.1 Age

The distribution of the sample by age and sex is shown in Table 1. The mean age of all respondents was 43 years (44 for male and 38 for female riders) and the range from 15 to 94 years. The majority (90.9%) of respondents were male. This distribution compares well with the average European data collected where 85% of the sample was male and 15% female. However, there is a large difference between the UK and Italian dataset where 21% of riders were female.

The age distribution by sex for UK subjects was fairly similar with a peak for male respondents aged around 36-40, and a peak for female respondents aged 31-35. This also corresponds well with the European average data where a mean age of 36.2 and 33.6 which was reported for male and female respondents respectively.
Table 1 - Number of respondents by age and sex

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Sex</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Count</td>
<td>Count</td>
<td>Count</td>
</tr>
<tr>
<td></td>
<td></td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>16-20</td>
<td></td>
<td>421</td>
<td>106</td>
<td>527</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.1</td>
<td>10.4</td>
<td>4.7</td>
</tr>
<tr>
<td>21-25</td>
<td></td>
<td>317</td>
<td>73</td>
<td>390</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.1</td>
<td>7.1</td>
<td>3.5</td>
</tr>
<tr>
<td>26-30</td>
<td></td>
<td>663</td>
<td>121</td>
<td>784</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6.5</td>
<td>11.8</td>
<td>7.0</td>
</tr>
<tr>
<td>31-35</td>
<td></td>
<td>1301</td>
<td>173</td>
<td>1474</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12.7</td>
<td>16.9</td>
<td>13.1</td>
</tr>
<tr>
<td>36-40</td>
<td></td>
<td>1723</td>
<td>170</td>
<td>1893</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.8</td>
<td>16.6</td>
<td>16.8</td>
</tr>
<tr>
<td>41-45</td>
<td></td>
<td>1643</td>
<td>115</td>
<td>1758</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.0</td>
<td>11.3</td>
<td>15.6</td>
</tr>
<tr>
<td>46-50</td>
<td></td>
<td>1199</td>
<td>80</td>
<td>1279</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.7</td>
<td>7.8</td>
<td>11.4</td>
</tr>
<tr>
<td>51-55</td>
<td></td>
<td>1167</td>
<td>75</td>
<td>1242</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.4</td>
<td>7.3</td>
<td>11.0</td>
</tr>
<tr>
<td>56-60</td>
<td></td>
<td>781</td>
<td>50</td>
<td>831</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.6</td>
<td>4.9</td>
<td>7.4</td>
</tr>
<tr>
<td>61+</td>
<td></td>
<td>1028</td>
<td>59</td>
<td>1087</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.0</td>
<td>5.8</td>
<td>9.6</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>10243</td>
<td>1022</td>
<td>11265</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

4.2.2 Distance travelled

The average annual distance travelled using a PTW by the survey respondents was 4677 miles (7527km), with 4823 miles (7762km) for male and 3109 miles (5003km) for female riders. Table 2 shows the distribution. The UK average distance is 414 miles (666km) higher than the PI Sa European survey average, where the mean annual travel was 4263 miles (6861km). However, the UK data was within 175 miles (282km) of both the German and Dutch rider’s annual distance travelled who reported a 4799 miles (7724km) and 4852 miles (7808km) annual travel distance respectively. This is due to the significantly lower travelled distance of Italian riders, averaging only 3286 miles (5289km). This is a likely consequence of the PTW type and use, which is reported to differ considerably for Italian respondents.

For the UK survey, the most frequently reported annual mileage range for both male and female respondents was 1001-2000. Very few respondents (2.6%) reported mileage of 15,000 and over. Males tended to ride higher mileages than females, relatively few of whom reported annual mileages of more than 3,000 miles.

Table 2 - Annual PTW distance travelled by sex
### Experience

The UK subjects were asked how long in total they had been riding on public roads, ignoring any long periods when they had taken a break from riding. They reported a mean level of experience of 15 years (16 for male and 8 for female riders) ranging from less than a year's experience to 73 years experience. The PISa European survey data reported an average of 13.7 years. This can be explained, in part, by differences in the riding population reported for these countries.

For UK data, as expected, most young motorcyclists only have a few years of experience, whereas the older the rider the larger the range of experience. However, around 16% of men and 30% of women over 40 were found to have less than five years experience. The 41-45 age groups in particular have a large proportion of relatively inexperienced riders, with 21% of men and 49% of women reporting less than 5 years riding experience.

### Size of bike

The most popular bike size for summer riding by male riders was 501-600cc (17.5%); for females it was 1-50cc (31.6%) and the proportions of male respondents reported riding bikes of 901-1000cc and over 1001cc was 10.2% and 14.4% respectively, whereas the corresponding figures for females were considerably lower (1.9% and 3.4% respectively). Few respondents, males or females, reported riding bikes with an engine size in the range 126-250cc (5.5% and 5.4% respectively). This data is difficult to relate to PISa European survey data but it provides an indication that male riders tend to ride larger bikes than females, in the UK at least.
4.2.5 Bike use

Respondents were asked how often they had ridden different types of motorcycle during the summer and winter and to state the total mileage they had ridden on each type of bike. For each type of bike, the respondent was asked to tick one of the ‘frequency-of-use’ categories (daily, weekly or monthly). Generally, respondents rode PTWs less frequently in winter than summer, though use depended to some extent of the type of bike. For example, 52.2% of sports motorcycles were used at least weekly in the summer and 28.3% during the winter. In the case of ‘commuting/roadster’ and ‘scooter’ use there was a significant proportion of respondents who reported ‘daily’ use (13-15%), regardless of season.

In the case of ‘sports’, ‘touring’ and ‘commuting/roadster’ motorcycles, the most frequently reported mileage figure for the last 12 months was, 1001-2000 miles. However, the most frequently reported mileage category for ‘off-road’, ‘classic’, ‘scooter’ and ‘moped’ categories of motorcycle was 1-500 miles in the year. Very high mileages of 10,000+ miles were reported mainly by respondents riding sports, touring and commuting /roadster motorcycles. In effect, the data shows that the type of PTW ridden varies with purpose of travel, which is in turn related to the season and mileage travelled.

Although this usage cannot be simply related to the data obtained in the European survey, the UK data is thought to offer a more realistic picture of the usage of the riding population as a whole. This is because UK data is not influenced by the site and time of the survey, which could be biased towards certain rider types or usage. A good example of this is for the German data which reported that only 3% of riding is economical reasons (commuting, travel or work). This may have been a consequence of surveys made at weekends in rural areas since more than 97% of riders reported ‘fun’ as the main reason for riding. Nevertheless, the UK data is likely to be roughly representative of the European survey as a whole given that almost the reverse trend was observed for Dutch data, where 69% of riders were categorised as riding for ‘fun’.

4.3 Accident characteristics

It will be seen from Table 3 that in all, 1509 accidents dated within the 12 month period were reported.

Table 3 - Number of accidents in a 12-month period (according to the dates supplied)

<table>
<thead>
<tr>
<th>Accidents</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>%</td>
<td>Number</td>
<td>%</td>
<td>Total</td>
</tr>
<tr>
<td>0</td>
<td>8663</td>
<td>88.7%</td>
<td>796</td>
<td>84.6%</td>
<td>9459</td>
</tr>
<tr>
<td>1</td>
<td>922</td>
<td>9.4%</td>
<td>118</td>
<td>12.5%</td>
<td>1040</td>
</tr>
<tr>
<td>2</td>
<td>144</td>
<td>1.5%</td>
<td>24</td>
<td>2.6%</td>
<td>168</td>
</tr>
<tr>
<td>3</td>
<td>27</td>
<td>0.3%</td>
<td>0</td>
<td>0.0%</td>
<td>27</td>
</tr>
<tr>
<td>4+</td>
<td>10</td>
<td>0.1%</td>
<td>3</td>
<td>0.3%</td>
<td>13</td>
</tr>
<tr>
<td>Number of accidents</td>
<td>1331</td>
<td></td>
<td>178</td>
<td></td>
<td>1509</td>
</tr>
<tr>
<td>Number of Accident involved riders</td>
<td>1103</td>
<td>11.3%</td>
<td>145</td>
<td>15.4%</td>
<td>1248</td>
</tr>
</tbody>
</table>
Of the 1495 accidents for which detailed were obtained 629 involved damage only, 664 involved injury to the rider involved in the accident and 187 involved a serious injury or a fatality. For each the rider was asked; ‘To what extent do you think you were to blame for the accident(s)?’ with possible responses of ‘not at all’, ‘a little’, ‘quite a lot’ and ‘entirely’. Overall, riders felt that they were ‘not at all’ to blame in 57% of accidents, to blame ‘a little’ in 20% of accidents, to blame ‘quite a bit’ in 6% of accidents and ‘entirely’ to blame in 17% of accidents. These opinions depended somewhat on the accident type and circumstances.

The most frequently reported accident category (apart from ‘other’, which applied to 25% of accidents) was the bike leaving the road without colliding with any other object (23%). The riders considered themselves mainly to blame in 36% of these accidents. The next highest category was that in which another vehicle collided with the rider (20%). The riders only consider themselves mainly to blame in 7% of these cases. In accidents in which the rider collided with another vehicle (17%), 22% or riders considered themselves to be mainly to blame. No other classification in this question exceeded 5%.

Most accidents (68%) were classified as occurring in built-up areas. The riders considered that they were mainly to blame for 19% of these accidents. 28% of accidents were classified as occurring on country/rural roads and riders considered themselves to be mainly to blame for 33% of these accidents.

Most accidents (57%) occurred in fine conditions, and 21% of these were considered to be mainly the riders’ fault. The next most frequent condition in which accidents occurred was in the rain or on a wet road. This category accounts for 19% of accidents, and 25% of riders considered themselves mainly to blame for this category of accidents. Just over three-quarters of accidents (76%) happened during daylight hours.

Over half of the accidents reported (55%) occurred during commuting or work related riding, and it is likely that most of these would have been in built-up areas. Riders considered themselves not to blame for 59% of these accidents. 42% of accidents occurred when riding for pleasure, and 29% of these were thought to be mainly the rider’s fault.

Sports and sports tourer bikes account for the largest group of accidents with scooters accounting for the next largest group. Just over 50% of sports and sports tourer bikes were being used for pleasure purposes when the accident occurred, whereas about 60% of scooters and commuting/roadster bikes were being used for commuting purposes when the accident occurred. These three types of bike (i.e. scooter, commuting/roadster and sports/sports tourer) account for two thirds of the bikes in the sample of accidents.

4.4 Motorcycling risk factors
An important focus of the project was to identify factors influencing motorcycle accident risk so that they can be used (a) to help explain trends in accident numbers and (b) to help identify priorities for remedial countermeasures. It is beyond the scope of this document to fully document the relatively complex analysis completed, but key findings are summarised below.

4.4.1 Exposure to risk
Exposure to risk, which consists of not just mileage, but the type of roads used and journeys undertaken, is clearly an important factor in the likelihood that a rider will be accident involved. The relationship between the annual miles ridden and accident involvement during the past 12-months is shown in Figure 40. The figure shows as expected that as the number of miles ridden increases then the likelihood of being involved in an accident increases. It also shows that the probability of being accident involved at most levels of mileage is higher for females than for males.
4.4.2 Engine size and type of bike

Another factor that is potentially an important influence on accident involvement is the ‘size’ of bike being ridden (‘size’ in this context refers to engine size). This analysis is based on engine capacity which is somewhat restrictive since engine size and power (and power to weight ratio) are not necessarily simply related.

Figure 41 summarises the proportion of accidents by bike capacity for ‘all accidents’ reported in the survey, ‘non-minor’ accidents (those not classified by the respondent as a minor spill or
a low speed manoeuvring accident), ‘no-injury’ accidents, ‘slight injury’ accidents (i.e. accidents resulting in cuts and bruises) and ‘serious injury’ accidents (e.g. those needing hospital care). These categories are not all mutually exclusive.

For ‘all accidents’, riders of motorcycles with engines up to 125cc have a much higher probability of accident involvement than riders of larger motorcycles, but beyond 125cc there is no obvious relationship between engine size and accident involvement. However, the excess accident involvement for bikes up to 125cc decreases as accident severity increases, such that for ‘non-minor’ accidents and ‘serious injury’ accidents there is no clear relationship between engine size and accident involvement across the whole range of bike size.

This finding is in contrast to those of a literature review commissioned by the European Commission (TNO, 1997) which reported that there was “no scientific evidence that engine size is a major factor in motorcycle accidents; engine size does not emerge as a risk factor.” The evidence reviewed by TNO indicated that (a) accident risk per year increases with engine size (mainly because larger bikes have a higher annual mileage), (b) accident risk per mile does not increase with engine size, and (c) risk of fatality per mile may increase with engine size. However, the relatively high accident involvement for bikes of 125cc and below is confined to the less severe accidents – i.e. those with slight or no injuries and even if an apparent relation between accident involvement and bike size exists, this does not imply a causal link between the two because other factors, such as type of use, exposure, and rider age and experience are all associated with the size of bike ridden as well as with accident involvement.

Indeed, Figure 42 shows accident involvement for the different engine sizes, adjusted for annual mileage (falling line, average number of accidents x 104/ the average annual mileage^0.4). This mileage exponent was derived from a regression of mileage with accidents and is used to provide an accident liability index that adjusts realistically for mileage effects. The relative inexperience and youth of riders of smaller bikes can clearly be seen. Figure 43 shows similar information for the various categories of motorcycle. Clearly, moped and scooter riders have the highest adjusted (for mileage) accident risk and tend to be ridden by those riders with least experience.

**Figure 42 - Age, experience and mileage adjusted accidents for different capacity of bikes**
A regression technique, known as generalised linear modelling, was applied to this data and revealed a strong age effect of age and experience on accident liability. The age effect alone means that a 26 year old novice rider would have an accident liability about 40% lower than that of a 17 year old novice who rode the same number of miles in the same conditions. A novice who was aged 40 years would have an accident liability 60% lower than the 17 year old novice. The effect of experience alone means that a rider with 10 years of experience would have an accident liability 38% lower than a rider of the same age but with only one year’s experience.

Operating together, the effects of age and experience mean that a 17 year old rider with one year of experience would see his accident liability fall by about 50% by the time he had accumulated 6 years of experience at age 22 years, and by 65% by the time he reached 27 with 11 years experience. The results are similar to those found by Taylor & Lockwood (1990), although the absolute accident frequencies are lower than those predicted around this time. The effect of age is still very strong on accidents. Clearly, age and experience (or, rather, youth and inexperience) are important risk factors in motorcycling as they have been shown to be in car driving.

**4.4.3 Type of experience/exposure**

The average accident involvement of riders classified by variables such as frequency of use (monthly, weekly, daily), type of road (built-up, country/rural roads, and motorways/dual carriageways), weather and lighting conditions and seasonal effects (winter/summer) was calculated from the raw data. This simple univariate analysis does not however yield easily interpretable results because of the complex interactions between these variables and the age, experience and exposure variables already considered. Thus for example, accident involvement may be higher for those riding in winter than in summer – but whether this is simply a reflection of increased annual mileage, or whether it indicates that winter riding is
intrinsically more risky than summer riding, cannot be ascertained from such a simple analysis.

A ‘rider dedication’ hierarchy, consisting of 6 categories of riders, was derived ranging at one extreme from riders who ride in all circumstances including riding in the wet or dark during winter to those who ride only monthly, and only in the summer at the other.

Table 4 - Rider ‘dedication’ categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Conditions the rider is willing to ride in</th>
<th>Number of riders</th>
<th>%</th>
<th>Average mileage</th>
<th>Probability of being accident involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ride at least daily or weekly in the wet and/or dark during Winter, i.e. ride in all conditions</td>
<td>5154</td>
<td>45%</td>
<td>6,070</td>
<td>0.16</td>
</tr>
<tr>
<td>2</td>
<td>Ride at least daily or weekly during the Winter but not in the dark or wet</td>
<td>877</td>
<td>8%</td>
<td>4,300</td>
<td>0.11</td>
</tr>
<tr>
<td>3</td>
<td>Ride in all conditions during the Summer months but not ride in the Winter</td>
<td>3405</td>
<td>30%</td>
<td>3,690</td>
<td>0.07</td>
</tr>
<tr>
<td>4</td>
<td>Ride daily during the Summer, but not ride in the wet or dark or during the Winter</td>
<td>64</td>
<td>&lt;1%</td>
<td>1,980</td>
<td>0.05</td>
</tr>
<tr>
<td>5</td>
<td>Ride weekly during the Summer, but not ride in the wet or dark or during the Winter</td>
<td>520</td>
<td>5%</td>
<td>2,330</td>
<td>0.04</td>
</tr>
<tr>
<td>6</td>
<td>Ride monthly during the Summer, but not ride in the wet or dark or during the Winter</td>
<td>462</td>
<td>4%</td>
<td>2,050</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>Not definable or not known</td>
<td>878</td>
<td>8%</td>
<td>2,630</td>
<td>0.09</td>
</tr>
</tbody>
</table>

Table 4 shows the average mileage and the average probability of accident involvement in each of the groups and shows that, numerically speaking, there are two main groups of riders – Category 1, those who ride in all conditions throughout the year, including in the wet and dark, and Category 3, those who ride in all conditions during the summer, but do not ride in the winter. Even when the effects of annual mileage, age, experience, training and bike size been corrected for, the former have a much higher probability of accident involvement than the latter. This does not tell us whether there is a particularly high risk from all-year riding, or whether the effect is explained by the differences in annual mileage and rider characteristics, but it is presumed that this is at least partly due to differences in the type of journey as well as to adverse weather and lighting conditions, though rider differences may play a part as well.
4.4.4 Rider type, attitude and behaviour

Statistical analysis techniques showed that the reported frequency of errors was the most important behavioural contribution to accident involvement (once the mileage effect had been taken into account). Traffic errors (mostly associated with failures of hazard perception or observational skills) were the most consistent predictors. Control errors (mainly to do with difficulties of control associated with high speed, or errors in speed selection) were also important in some analyses. Stunt and speeding behaviours (i.e. 'violational' behaviours) also appeared as predictors of accident liability in some analyses.

The relative importance of the errors and violations found in the survey is in apparent contrast with findings from previous research on car drivers, in which self-reported violations are the stronger predictor of accident liability. This may result from the fact that motorcycles are more demanding to control than cars, and less forgiving of errors. However, the errors may themselves be closely linked with riding styles involving carelessness, inattention and excessive speed – i.e. styles that might be termed 'violational'.

When age and experience are not permitted to influence accidents directly, stunt/high risk behaviours become significant predictors of accidents. This is consistent with the explanation that one of the risk-increasing characteristics of young or inexperienced riders is their tendency to indulge in overtly risky behaviours.

Riding style, getting pleasure from motorcycling, and a liking for speed were identified as predictors of behavioural errors (that were, themselves, predictors of accidents). These predictors were also inter-correlated. Such relationships lend support to the view that an important part of the motorcycle safety problem stems directly from the motivations for choosing to ride motorcycles. This presents a challenging problem for road safety.

4.5 Summary of UK survey and analysis

- The survey achieved an 11,360 (40%) response rate. Given the high response rate and random sampling, this survey provides a good representation of UK PTW rider population.
- The mean age of all respondents was 43 years (44 for male and 38 for female riders), the majority of respondents were male (90.9%).
- The average annual mileage for the survey respondents was 4677 miles (7527km) with 4823 miles (7762km) for male and 3109 miles (5003km) for female riders with males tending to ride higher mileages than females.
- The UK mean level of experience reported was 15 years (16 for male and 8 for female riders) whereas the PISa European survey data average was 13.7 years.
- The most popular bike size for summer riding by male riders was 501-600cc (17.5%); for females it was 1-50cc (31.6%) and this highlights that male riders tend to ride larger bikes than females.
- Respondents rode less frequently in winter than summer but use was dependant on bike type. For example, 52.2% of sports motorcycles were used at least weekly in the summer and 28.3% during the winter. In the case of 'commuting/roadster' and 'scooter' use there was a significant proportion of respondents who reported 'daily' use (13-15%), regardless of season.
- Most accidents (68%) were classified as occurring in built-up areas. And, most accidents (57%) occurred in fine conditions.
• Over half of the accidents reported (55%) occurred during commuting or work related riding, and it is likely that most of these would have been in built-up areas.

• Just over 50% of sports and sports tourer bikes were being used for pleasure purposes when the accident occurred, whereas about 60% of scooters and commuting/roadster bikes were being used for commuting purposes when the accident occurred.

• For ‘all accidents’, riders of motorcycles with engines up to 125cc have a much higher probability of accident involvement, however, this trend decreases as accident severity increases.

• For ‘non-minor’ accidents and ‘serious injury’ accidents there is no clear relationship between engine size and accident involvement across the whole range of bike size.

• Moped and scooter riders have the highest adjusted (for mileage) accident risk and tend to be ridden by those riders with least experience.

• There is a strong age effect of age and experience on accident liability such that the effects of age and experience mean that a 17 year old rider with one year of experience would see his accident liability fall by about 50% by the time he had accumulated 6 years of experience at age 22 years, and by 65% by the time he reached 27 with 11 years experience.

• Two main groups of riders were identified; those who ride in all conditions throughout the year, including in the wet and dark, and those who ride in all conditions during the summer, but do not ride in the winter. The former have a much higher probability of accident involvement than the latter.

• When age and experience were controlled for in the statistical analysis accidents stunts/high risk behaviours become a significant predictor of accidents.
5 Discussion of UK data (comparison with European survey data)

UK survey data has been shown to have similarities with the data collected in Germany, Italy and the Netherlands in terms of respondent characteristics, with the UK data imitating the average situation for these countries. Although differences are noticeable when comparing UK data with the individual countries directly, these differences are a reflection of differences in desired PTW function e.g. commuting versus fun riding, and the survey timing and sites used between countries. Nevertheless, the UK data poses a good representation of the average rider for the entire survey area.

TRL has analysed the UK survey and accident data to understand the interacting influences which determine motorcyclist accident (and casualty) liabilities. Given the close representation of the average respondent for the European survey, this data allows further observations to be made on the relationship between accident risk and the user acceptance of integrated safety systems which were included in the European survey (excluding the scooter PTW category).

European survey data indicates that the acceptance of Automatic Handling and Protection Systems (APHS) is variable depending on the particular system considered. This variability was shown to be dependent on the PTW type. In general, sport PTW riders were least interested in AHPS systems compared to touring and roadster PTW riders. This could be attributed to the motivations of sport riding since the reliance on rider skill contributes to the fun aspect of riding. APHS may be perceived to reduce the level of skill and control and diminish the fun factor. This is especially applicable for sport riders who are shown to have the most reckless driving style. Importantly, UK data has shown that a liking for speed is a predictor of behavioural errors and, in turn, a predictor of accidents. Therefore, it appears that the very people who could benefit from an AHPS system are those most likely to reject such a system. This indicates a potential conflict between user acceptance and the potential benefit of the systems.

Despite this, it has been shown that AHPS systems are more popular than Collision Warning Systems (CWS) and Automatic Driving Task Support (ADTS) systems presented. Indeed, ABS and ESP systems were identified as those systems that PTW riders would be willing to spend the most money on. This may indicate a better understanding of the systems by the PTW riders, possibly due to the awareness of such products in car technologies. This finding also indicated that these systems are likely to be considered most favourably by PTW manufacturers. For this reason, AHPS systems may be most readily implemented and provide the most immediate safety benefits.

The lack of interest in CWS systems could be attributed to a combination of lack of understanding of the systems - as few of these systems are currently available in automotive applications, and the dislike of reduced rider control e.g. AFA which provides intervention actions when riding too close to the leading vehicle. However, these systems are well suited to inexperienced riders where the risk of accidents is much higher due to reduced hazard perception and observational skills. The high risk of this rider group is demonstrated in Figure 43. Given the perceived benefits for this group, CWS should be targeted towards inexperienced rider groups and towards low powered PTWs which have been linked to this rider group. This approach would improve the acceptance of systems by exposure and the scope to expand this technology to greater bike sizes as rider experience and bike size progress. Since there is little to differentiate between the acceptances of each individual CWS system, the prioritisation of the systems for implementation should be driven by the potential benefits in terms of safety.

Automatic Driving Task Support (ADTS) systems were generally perceived as undesirable by the respondents, in a similar way to the CWS systems. However, GPS navigation systems,
enhanced night display (ND) systems were viewed marginally more favourably and an automatic gearbox (AGB) less so. It is thought that the acceptance of these systems is somewhat dependent on the purpose of riding, since they are focused on particular riding habits. For example, ND would be less desirable to riders who ride neither in the dark or during winter, a group which accounts for almost 48% of the UK riders surveyed. Similarly, GPS would be less acceptable to low mileage commuting riders than high mileage touring rider types. For this reason, ADTS may be less widely applicable and individual systems should therefore be targeted towards the most appropriate rider groups. On this basis, it would appear that the priority systems, for the UK at least, would be GPS and ND, for high mileage all weather riders who account for 45% of the UK riders surveyed.
6 Conclusions

The total number of correspondents cannot be regarded as being representative for the group PTW drivers in the EU because of the limited amount of countries involved in this study (only GE, I and NL) and also for the concentration of correspondents for Italy and Germany (close to Munich). However, it provides user information for a large group of different types of riders from Germany, Italy and the Netherlands. Furthermore, evidence from an extensive UK survey suggests that the characteristics of the average EU survey respondents are comparable to that of the UK. And, given the high response rate and random sampling, this survey provides a good representation of the UK PTW rider population. The UK survey data is summarised in Section 4.5.

The participants of all the three different countries drove often on rural roads, quite often on urban roads, sometimes on motorways and hardly ever on unpaved roads. The German participants drove less frequently on urban roads compared to the other two countries and the Dutch participants drove more frequently on motorways compared to the other two countries. UK data indicates that most accidents (68%) were classified as occurring in built-up areas and over half of the accidents reported (55%) occurred during commuting or work related riding.

The driving circumstances differed amongst all three different countries: the participants drove always in fair weather and during daytime, often during twilight and in queued traffic, quite often during night and in the rain and hardly ever in the snow. The Italian participants drove more frequently during night and twilight compared to the other two countries and the German participants drove less frequently (hardly ever) in rain and snow compared to the other two countries. The UK data identifies two main groups of riders; those who ride in all conditions throughout the year, including in the wet and dark, and those who ride in all conditions during the summer, but do not ride in the winter. The former have a much higher probability of accident involvement than the latter.

The German participants drove mainly for fun. For the Dutch participants it seemed that the participants that drove a sport PTW, roadster, a cruiser or an off-road PTW, drove also mainly for fun. The participants that had a touring PTW drove mainly for economical reasons.

With the scooter drivers included it seemed that the Italian drivers that drove a sport PTW, touring PTW, roadster, a cruiser or an off-road PTW, drove mainly for fun. The participants that had a scooter with an engine size of less than 250cc or a scooter with an engine size of more than 250cc drove mainly for economical reasons. Additionally, there was no clear relation found between the reason for driving a PTW and the amount of driven kilometres, the different road types that were driven and the different circumstances.

The analysis for all data excluding the scooter drivers showed that the German and Dutch participants drove less recklessly than the Italian participants. It was also shown that the participants that drove a sport PTW drove more recklessly than the participants that drove a touring PTW or a cruiser. The participants that drove a roadster of an offroad PTW drove also more recklessly than participants with a cruiser.

The analysis including scooter illustrated that the participants that had sport PTW), an offroad PTW, a scooter with an engine size of less than 250cc or a scooter with an engine size of more than 250cc drove more recklessly than participants that had a cruiser.

It could be concluded that the protection that is most often worn is of the following order:

1. Helmet
2. Motor jacket, motor gloves
3. Boots, motor suit
4. Motor trousers, earplugs, body protector, knee pads and kidney belt

Overall, the Italian participants seemed to wear less protection compared to the German and Dutch participants.

The outcome of the questionnaires referring to the desired systems showed that the PTW drivers were in favour for direct driving support systems such as ABS, ESP, Night vision displays etc. Automatic support systems, taking away tasks from the PTW driver were disliked. It also seemed that the Italian drivers were more interested in the enhanced vision/night vision display than the other two countries. This could be related to the circumstances that the participants drove in. The Italian drove more during night and twilight than German and Dutch participants.

A comparison of the UK and EU survey data indicates that a potential conflict may exist between user acceptance and the potential benefit of the systems. For example, sport PTW riders were least interested in AHPS systems yet these riders are shown to have the most reckless driving style and a liking for speed is a predictor of behavioural errors and accidents liability. It may therefore be inappropriate to promote systems on user acceptance alone. However, given the popularity of these systems, particularly ABS and ESP, due to the automotive origins, they may be the most viable for implementation by manufacturers and provide the most immediate safety benefits.

CWS systems had a low popularity but could provide significant safety benefits. It was judged that these benefits could be most appropriate for inexperienced riders of low powered PTWs, who may have the lower resistance to their introduction if cost is negligible. Since there is little to differentiate between the acceptances of each individual CWS system, the prioritisation of the systems for implementation can be driven by the potential benefits in terms of safety.

ADTS systems were generally perceived as undesirable by the EU respondents but GPS navigation systems, enhanced night display (ND) systems were most favoured. The acceptance of ADTS systems appeared to be dependent on the purpose of riding and systems should be prioritised by the size of the rider groups. For the UK, GPS and ND systems therefore appear feasible solutions, given that high mileage all weather riders account for 45% of the UK riders surveyed.
7 References

Reference to an article:

MAIDS 2004: In depth investigations of incidents involving PTW’s. September 2004, ACEM
- Avenue de la Joyeuse Entrée 1 – 1040 Brussels


8 Appendix
Questionnaire for motorcycle driver

Short introduction

This is a short questionnaire about the use of your motorcycle. By filling in this form you could help us to improve the safety of motorcycle drivers, like yourself, and the safety of the other road users. Finishing this questionnaire will take less than 10 minutes.

Most questions are multiple choice, but if your preferred answer is not listed, you can always extend the list with your answer and feel free to add remarks.

If you do not understand a question or you just can not answer it, please give a short remark why. Sometimes it will be sufficient to indicate that the question is in your case not applicable.

We would like to thank you very much for your contribution to this research by filling in this questionnaire.

This interview will be dealt with anonymously. Only the researchers will have access to this information.

If you send us the fully finished form, we will send you, as a mark of gratitude of your contribution to our research, a coupon of € 10,- which can be cashed at several stores. Therefore we will need to have your name and address. If you are interested, please write down your address below. We will deal with this information confidentially and destroy it after the coupon has been sent to you.

Name: ________________________________________
Address: ________________________________________
Postcode: ________________________________________
Place: ________________________________________

It is also possible to give the € 10,- to charity which you could indicate below.

[  ] Vereniging verkeersslachtoffers
[  ] Stichting bescherming verkeersslachtoffers
[  ] Nederlandse brandwondenstichting
[  ] Rode kruis
[  ] Stichting cliniclowns
[  ] Nationaal revalidatiefonds
[  ] 3VO (VVN)

This above will be destroyed after the coupon has been sent to you.
**Background information**

**General**

First some information will be asked about yourself and your personal situation. Please fill the box for the answer that is applicable for you.

1. Are you a man or woman?
   - [ ] man
   - [ ] woman

2. What is your age?
   
   ____________ years.

3. Do you have children?
   - [ ] no
   - [ ] yes

4. What is your highest level of education?
   
   That is: ________________________________

5. What is your height?
   
   _____ cm

6. What is your weight?
   
   _____ kg

7. What is your occupation?
   
   ________________________________

8. What motorcycle do you drive?
   
   - Make: ________________________________
- Model: ________________________________
- Year: ________________________________
- Total Km: __________________________
- Insurance condition: __________________

**General traffic behavior**
The following questions are about your driving experience and your behavior in traffic.

9. Which driving licenses do you have and when did you obtain these licenses?

<table>
<thead>
<tr>
<th>License type</th>
<th>Year obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] A: Motorcycle license</td>
<td></td>
</tr>
<tr>
<td>[ ] B: Driving license</td>
<td></td>
</tr>
<tr>
<td>[ ] C: Truck license</td>
<td></td>
</tr>
<tr>
<td>[ ] D: Bus license</td>
<td></td>
</tr>
<tr>
<td>[ ] E: Trailer license in combination with B C D</td>
<td></td>
</tr>
<tr>
<td>[ ] Moped certificate</td>
<td></td>
</tr>
<tr>
<td>[ ] Something else, namely:</td>
<td></td>
</tr>
<tr>
<td>[ ] Non</td>
<td></td>
</tr>
</tbody>
</table>

10. What is your experience with motorized vehicles?

Total (all vehicles) _______ kilometer per year or latest year
The motorcycle(moped) _______ kilometer per year or latest year

11. Did you attend extra training or driving proficiency courses for the last two years?

[ ] yes, namely: ____________________
[ ] no

12. Do you think that other road users are sufficiently aware of the motorcyclist’s behavior?
[ ] yes
[ ] no, because: _________________________________________________________
[ ] no, not in general, because: ___________________________________________

13. How often do you drive on the following trajectories?

<table>
<thead>
<tr>
<th>Trajectory</th>
<th>never</th>
<th>hardly ever</th>
<th>sometimes</th>
<th>quite often</th>
<th>often</th>
<th>almost always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban road</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Rural road</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Motorway</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Unpaved</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

14. Would you drive in the following circumstances?

<table>
<thead>
<tr>
<th>Circumstance</th>
<th>never</th>
<th>hardly ever</th>
<th>sometimes</th>
<th>quite often</th>
<th>often</th>
<th>almost always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nice weather</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Rain</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Snow or freezing drizzle</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Day</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Night</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Twilight</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Between 2 lanes of queued traffic</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
15. What is the most important reason for you to drive a motorcycle(/moped)?

[ ] 1: Motorcycle holiday
[ ] 2: Week-end ride
[ ] 3: Hobby/sport (off-road, race etc)
[ ] 4: Economical benefit, less consumption than a car (commuter traffic)
[ ] 5: Economical benefit, shorter traveling time (commuter traffic)
[ ] 6: By way of profession

16. What is your driving style? The number 1 indicates a calm driver up to 7 which indicates a reckless driver. Please circle a number from 1 to 7.

Calm: 1------2------3------4------5------6------7: Reckless

17. What is the best way to describe your driving behavior?

[ ] 1: Social
[ ] 2: Dreamy/not paying attention
[ ] 3: Careless
[ ] 4: Sporty/assertive
[ ] 5: Impatient/hasty
[ ] 6: Quick-tempered
[ ] 7: Daredevil

18. Indicate for which offences with the motorcycle(/moped) you received a fine this year and how many (more than 1 answer possible)

<table>
<thead>
<tr>
<th>Offence</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speeding, less than 10km/h too fast</td>
<td>_______ offences</td>
</tr>
<tr>
<td>Speeding, more than 10km/h too fast</td>
<td>_______ offences</td>
</tr>
<tr>
<td>Parking violation</td>
<td>_______ offences</td>
</tr>
<tr>
<td>Driving through red light</td>
<td>_______ offences</td>
</tr>
<tr>
<td>Drunk too much alcohol</td>
<td>_______ offences</td>
</tr>
</tbody>
</table>
[ ] Not having your driving license on you _______ offences
[ ] No insurance _______ offences
[ ] Tailgating _______ offences
[ ] Stick on the overtaking lane _______ offences
[ ] Use of mobile phone while driving _______ offences
[ ] No lights on _______ offences
[ ] Extreme maneuvers (wheelies, stoppies, drift etc) _______ offences
[ ] Something else, namely: ________________________ _______ offences

19. Do you sometimes drive without the following protection (more than 1 answer possible)?

[ ] 1: No
[ ] 2: Helmet
[ ] 3: Motor jacket
[ ] 4: Motor trousers
[ ] 5: Motor suite
[ ] 6: Motor gloves
[ ] 7: Boots
[ ] 8: Earplugs
[ ] 9: Body protector
[ ] 10: Back protector
[ ] 11: Knee-pads
[ ] 12: Kidney belt
20. Do you sometimes drive your motorcycle with a passenger?

- [ ] no
- [ ] yes

<table>
<thead>
<tr>
<th>If yes, how often?</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
</table>

21. Do you sometimes drive with luggage, if yes how many and which location (more than 1 answer possible)?

- [ ] no
- [ ] yes, with ……. pieces: [ ] Backpack
- [ ] Tank bag
- [ ] Top suitcase
- [ ] Side suitcases
- [ ] Something else _____________

22. Are you sometimes bothered by a passenger and/or luggage or something else? (e.g. helmet, wind, rain, vibrating mirrors etc.)?

<table>
<thead>
<tr>
<th>Passenger</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luggage, location: ___________</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Something else, namely ___________</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Something else, namely ___________</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Something else, namely ___________</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
23. How often do you do the following activities on the motorcycle (/moped)? (More than 1 answer possible)?

<table>
<thead>
<tr>
<th>Activity</th>
<th>never</th>
<th>hardly ever</th>
<th>sometimes</th>
<th>quite often</th>
<th>often</th>
<th>almost always</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using mobile phone</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Operating navigation system</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Eating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Drinking</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Reading map</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Something else, namely:</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

24. How many accidents did you have in the past 5 years with the motorcycle (/moped) and could you give some information about these accidents?

________ accidents

<table>
<thead>
<tr>
<th>Accident</th>
<th>Description/causes</th>
<th>Damage/Injuries driver and/or passenger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accident 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accident 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
25. Which of the following dangerous situations or situations that scared you have you encountered and which action did you undertake?

<table>
<thead>
<tr>
<th>Description/causes</th>
<th>Undertaken action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane change without indicating.</td>
<td>0</td>
</tr>
<tr>
<td>Vehicle in blind spot while changing lane</td>
<td>0</td>
</tr>
<tr>
<td>Corner radius smaller than estimated/taking the corner too fast</td>
<td>0</td>
</tr>
<tr>
<td>Spinning rear tire when accelerating in the corner</td>
<td>0</td>
</tr>
<tr>
<td>Slipping front tire during braking (perhaps due to slipperiness)</td>
<td>0</td>
</tr>
<tr>
<td>Sudden braking by lead traffic</td>
<td>0</td>
</tr>
<tr>
<td>Overtaking where it was hardly possible</td>
<td>0</td>
</tr>
<tr>
<td>Something else,_________________________________________________________________</td>
<td>0</td>
</tr>
</tbody>
</table>
26. Which of the following systems would you like to see implemented in a motorcycle, how much would you spend on this system and would you like to turn the system off?

<table>
<thead>
<tr>
<th>System</th>
<th>No</th>
<th>€ 0</th>
<th>€&lt; 100</th>
<th>€&lt; 500</th>
<th>€&lt; 1000</th>
<th>€&lt; 2000</th>
<th>Turn off</th>
</tr>
</thead>
<tbody>
<tr>
<td>A system that prevents the wheels to lock when braking (ABS)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A system that prevents spinning when accelerating too fast (in a corner)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A system that prevents the motorcycle to become unstable when braking hard together with a steering maneuver</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A system that maintains a constant speed: Cruise Control</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A system that maintains a constant speed and keeps a certain distance with respect to a lead vehicle by decelerating automatically: Adaptive/Intelligent Cruise Control</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A system that provides a warning when you are too close to lead vehicles</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A system that provides a warning when you are too close to lead vehicles and intervenes automatically</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A system that automatically adapts the suspension to the type of road.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hands free mobile phone</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Automatic gearbox</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Navigation system</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A display that improves the view by night, fog and/or rain.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A system that provides a warning signal you are unintentional departing the lane: Lane Departing Warning</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A system that provides a warning when there is someone next to you (overtaking)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A system that keeps you on the motorcycle during an accident and offering the right protection</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
A system that minimizes the pitch when braking

A system that provides support when driving between the 2 lanes of queued traffic

Something else, namely:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
</table>

Finally

If you like to extend some of your answers or you have some remarks, you can use the extra space on this page to do so.

Thank you very much for your time and effort by filling in this questionnaire!

This interview will be dealt with anonymously. Only the researchers will have access to this information.
### Main PTW styles

<table>
<thead>
<tr>
<th>Description</th>
<th>PTW pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Roadster</strong></td>
<td><img src="image1" alt="Roadster" /></td>
</tr>
<tr>
<td>Conventional street style PTW (OECD)</td>
<td><img src="image2" alt="Roadster" /></td>
</tr>
<tr>
<td>Standard - Traditional motorcycles mainly designed as practical transportation. This category falls in the middle of the spectrum in most areas of ergonomics and performance, including power, handling and braking. (FEMA)</td>
<td><img src="image3" alt="Roadster" /></td>
</tr>
<tr>
<td><strong>Cruiser</strong></td>
<td><img src="image4" alt="Cruiser" /></td>
</tr>
<tr>
<td>Chopper style PTW (OECD)</td>
<td><img src="image5" alt="Cruiser" /></td>
</tr>
<tr>
<td><strong>Cruiser</strong></td>
<td><img src="image6" alt="Cruiser" /></td>
</tr>
<tr>
<td>Cruiser style PTW (OECD)</td>
<td><img src="image7" alt="Cruiser" /></td>
</tr>
<tr>
<td>Cruiser - Once dominated exclusively by Harley-Davidson, the cruiser category has now attracted competition from all major manufacturers. The profile is long with a low saddle height. The emphasis is on appearance, style and sound, with less emphasis on performance.</td>
<td><img src="image8" alt="Cruiser" /></td>
</tr>
<tr>
<td><strong>Offroad</strong></td>
<td><img src="image9" alt="Offroad" /></td>
</tr>
<tr>
<td>Enduro style PTW (OECD)</td>
<td><img src="image10" alt="Offroad" /></td>
</tr>
<tr>
<td>Enduro – A motorcycle used to compete in a sporting event or race on-road, off-road and cross country from one point to another, usually lasting hours or days, and emphasising timing, speed and reliability (ACEM 2004).</td>
<td><img src="image11" alt="Offroad" /></td>
</tr>
<tr>
<td><strong>Touring</strong></td>
<td><img src="image12" alt="Touring" /></td>
</tr>
<tr>
<td>Multi-Purpose - With long suspension travel, these machines are designed to be used both on asphalt and unmade roads. The category is growing more and more popular and are often called &quot;adventure bikes&quot;, as they offer the comfort, luggage capacity and durability needed for long-distance touring.</td>
<td><img src="image13" alt="Touring" /></td>
</tr>
</tbody>
</table>

| Scooter<250cc | Scooters - These two-wheeled vehicles are often small, mostly low-power designs in moped and light motorcycle categories with small-diameter wheels suitable for use on surface streets in urban environments. Their appearance differs significantly from motorcycles because of their bodywork and the "step-through" frame design. Although less common, a new generation of super scooters with engine capacities of up to 650 cc is becoming increasingly prevalent. They combine the virtues of traditional scooters with a long distance capability. |
| Scooter>250cc | Sport style PTW (OECD) **Supersport** - Styled and constructed in the manner of road-racing motorcycles with streamlined bodywork and forward-leaning riding position. The emphasis is on handling, acceleration, top speed, braking and cornering. Often lighter and more technologically advanced than other types of motorcycles, they are favoured for riding on twisting roads. |
| Sport | Sport-Touring - These motorcycles combine the comfort and some of the luggage capacity of touring bikes with the responsive handling of sport bikes. Usually powerful with high-performance brakes. The ideal mission of a sport-touring machine is medium and long-distance travel via challenging roads. |
| Scooter<250cc | Step-through style(OECD) |
| Touring | **Touring style**(OECD) **Touring** - Large, often very expensive motorcycles with luggage capacity and weather protection, designed to transport rider and passenger in comfort. Touring bikes are heavy with moderate power outputs. Their intended purpose is comfortable, long-distance travel. |