A qualitative study of the rider training system for younger riders in powered two-wheelers (PTW) class AM146 and A1, and its effect on risk.

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It is widely recognized that powered two-wheeler (PTW) riders have a particularly high accident risk, but little attention has been given the rider training programs and PTW-instructors. The aim of this study was to explore factors in the rider training systems that could provide safer riders by recognizing risk factors, and particularly the age group of 16- and 17-year-olds. The research question was; *How could the high accident rate for younger drivers on two-wheelers be related to the rider training system?* This is a part of a larger project on risk and safety factors for PTW-riders' in Norway. In this initiating part of the project, altogether 10 interviews with well-experienced PTW-rider instructors from different driving schools in Norway were conducted, as well as interviews with university lecturers educating PTW-rider instructors. Our findings of risk factors in PTW rider training for AM146 (moped) and A1 (light motorcycle) were (1) the number of learner riders, (2) course thinking, (3) evaluation criteria, and (4) economy. Our conclusion was that there are elements in the rider training system that could be improved. Measures such as allowing fewer learner riders per rider instructor and including a practical test for AM146 could potentially improve rider training for young riders. Additionally, this was found to be a phenomenon strongly connected with the debate of level of production versus level of safety.

Keywords: Powered two-wheelers, rider training, risk, young riders, AM146, A1, moped, light motorcycle, safety.

1. Introduction

In Europe, the accident exposure for riders of PTWs is significantly higher than for other vehicle road users (e.g. ERSO, 2018; Bjørnskau, 2016; Penumaka, Savino, & Baldanzini, 2014). The risk factors regarding PTWs are for instance speed, gender, time of day, age, frequency of riding, weather conditions, length of time holding a license, the trip purpose, and presence of passengers (Bjørnskau, Nævestad, & Akhtar, 2012; de Rome et al., 2016; Keall et al., 2012; Moskal et al., 2012). Additionally, not only does riding a PTW provide a higher risk in resulting in injury compared to other vehicles if an accident occurs, the likelihoods of these injuries being more severe are also higher. A reason for this is that PTWs are more difficult to handle for the rider compared to four-wheel vehicles. Difficulties such as hard braking, swerving or other evasive maneuvers are more challenging for someone handling a two-wheel vehicle than four-wheel vehicle. Additionally, a rider is less protected by the vehicle itself, so the poor conspicuity and the poor protection for riders are factors that contribute to a higher probability for more severe injuries. Of all those riding a PWT, it is recognized that especially young people, aged 16 and 17, are a group that is at particular high risk of being involved in accidents (Bjørnskau et al., 2012). As many as 22 % of moped riders and 27% of light motorcycle riders report unwanted incidents during their first year with license. (Sagberg & Johansson, 2018). Thus, this is the age group we focus on in this paper, and why AM146 and A1 is chosen.

Although there are many risk factors highlighted that makes PTW-riders prone to accidents and injuries, training is hardly mentioned. A knowledge gap could thus be said to be the level of competence of the riders and what happens before the riders hold a license. When looking at literature on rider training, the studies are often in one of three (1) studies testing the effectiveness of post-test training, (2) studies describing educational content of training, and (3) studies attempting to identify new educational content categories (Aupetit et al., 2013), but the theme is not covered in depth. Not much scientific research is conducted with the focus on how the training systems could be improved, and the literature concerning training in general mostly originates from the previous decade. In addition, most studies test the curriculum by analyzing accident data or self-report surveys for the PTW-rider (e.g. Haworth & Mulvihill, 2005; Sagberg &

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Johansson, 2018). Very little explores the driver training itself with the view of the PTW-instructors. For a Norwegian context, this aspect seems to be missing in scientific literature. Hence, the quality of the rider instructor education or rider training should be explored. We would like to investigate if there could be anything in the training that could give a hint of why the 16- and 17-year-olds are more at risk. There is research that implies that it is difficult to measure training's effect on safety (Mayhew and Simpson, 2002; Lonero and Clinton, 2006, Helman, Greyson and Parkes, 2010; Hirsch and Bellavance 2016), but still, those working closest to the group in a training situation, seem to be a group that is natural to speak to in regard to their view of the training system, and how it could be improved to get better skilled and safer young PTW-riders on the roads.

Thus, our research question is: *How could the high accident rate for younger drivers on two-wheelers be related to the rider training system?*

Further in this paper we will present safety theory, the different classifications of PTWs, and the training programs for PTWs allowed for 16 year-olds in Norway before method and results are presented. Thereafter there is a discussion linking the findings and the safety related theoretical framework, and a conclusion.

1.1 *Risk factors in a dynamic context*

There are several theories regarding how to deal with risk factors from a system perspective (e.g. Turner, 1978; Rasmussen, 1997; Reason, 1997; Perrow, 1999; Hollnagel, 2009; Weick and Sutcliffe, 2015). Here, we chose to focus on Rasmussen's theory of mitigating towards boundaries (Rasmussen, 1997). This theory is concerned with how decisions are not made in isolation, but rather made in the social context and established practices in the work environment. Hence, the interaction of the effects of decisions made by people in their normal work context must be taken into consideration. As an example, in a world where commercial success often benefits from operating close to safety boundaries, decisions will be affected by the competing goals of production and safety.

The boundaries mentioned include (a) perceived acceptable performance and an error margin, (b) unacceptable work load, and (c) economic failure. These boundaries are essential elements which are related to both organizations' production and safety. In order to prevent accidents, Rasmussen stated that the focus should be on "control of behaviour by *making the boundaries explicit and known* and giving opportunities to develop *coping skills at boundaries*" (Rasmussen, 1997, p. 191). This way, safety has the possibility to be maintained through an understanding of the specific work- and system context.

From a system perspective, human error is divided in two: active and latent errors. When explaining active errors, they are the ones committed of which the effect is immediately recognized. These errors are often related to the performance of the operator in the situation where the incident occurs. Latent errors, on the other hand, are errors committed in an earlier phase, which lie in the system before it comes evident, often in combination with other factors. These errors are often performed by those further from the specific action, that is personnel who are more removed from the day to day operations (Reason, 1990).

1.2 *PTW classifications*

To classify PTWs one often uses mopeds, scooters or motorcycles (Penumaka, et al., 2014). In addition, light (A1), standard (A2), and heavy (A) motorcycles are a normal classification for dividing motorcycles. Mopeds and scooters (AM146) have a speed limit of 45 km/h and self-weight of maximum 350 kg, while motorcycles have engines larger than 50cc and maximum speed exceeding 50 km/h. We look at two wheeled mopeds under 100 kg. The light motorcycle (A1), which is a classification between mopeds and standard motorcycles, are with engines from 50cc to 125cc, and a maximum effect of 11 kW. Motorcycles over 125 cc are classified as A2, standard motorcycles, and A, heavy motorcycles. We will be focusing on mopeds (AM146) and light motorcycles (A1) in this paper. The minimum age for receiving a driver's license for mopeds and light motorcycles is 16 in Norway, but the training for the two licenses has some differences, which will be described in the next section (see also Table 1). The minimum age for receiving a license for standard motorcycle is 18 and heavy motorcycle is 20 (EUR-Lex, 2006). In most research concerning PTW risk factors and outcome of accidents, these classifications are not differentiated (e.g. (Van Elslande & Elvik, 2012) Thus, it is a challenge to know the different challenges in these classes, or if there are differences.

1.3 *PTW rider training system in Norway for AM146 and A1*

The Goal for driver education (GDE) matrix (Hatakka et al, 2002b) has been the basic understanding of the driving skills that is necessary for a driver to have and thus, a central element in all road traffic training and education in Norway. It is the foundation all driver training is based on, including for PTWs. The GDE-matrix

consists of five levels, where the lowest level is vehicle maneuvering, the second level is mastering the road situations, the third level is goals and context of driving, the fourth level is goals for life and skills for living (Keskinen 1996 in Hatakka et al. 2002a), and the fifth level is social skills (Keskinen 2014; Keskinen et al. 2010). This basic has resulted in a four-level driver training in general in Norway, where one can say that level 1 is theoretical, level 2 is maneuvering, level 3 is tactical and level 4 is strategic.

The main learning goal for *the class AM146* is that the rider has adequate skills and knowledge necessary to responsibly operate a moped AM146. The training consists of four levels where 1 is a basic theoretical course, level 2 is basic vehicle handling, level 3 is an on-the-road part and level 4 is final training. Elements in level 1 are theoretical and include the riders' role in road traffic and how to interact with other road users in addition to some basic safety and risk evaluations and duties as a road user. Level 2 is practical where the learner rider learns how to operate the vehicle. Level 3 is an on-road training, where the learner rider has an individual training and safety course. Level 4 is a finishing part which include safety course in real life traffic. In this training, the rider instructor is allowed to ride with 3 learner riders in real life traffic. There is an assessment at the end of level 2 and 3 conducted by the PTW-rider instructor who together with the learner rider decides whether the learner rider has sufficient skills to attend the next level.

For *the class A1*, the main learning objective is for the rider to have adequate skills and knowledge necessary to responsibly operate a light motorcycle, A1. This training also consists of 4 levels where level 1 is theoretical knowledge, level 2 is maneuvering, level 3 is strategic and level 4 is mainly concerning risk perception and evaluation of one's own actions. During level 4, which includes a safety course in real life traffic, the rider instructor is allowed to instruct one learner rider, and not three as in AM146. For this class there is also an assessment the end of level 2 and 3 conducted by the PTW-rider instructor together with the learner rider to decide whether the learner rider has sufficient skills to attend the next level. The practical test is conducted after level 4 at a driver and vehicle licensing office at the Norwegian public road administration and must be passed in order to receive a license.

Table 1. Similarities and differences between moped and light motorcycle training and license demands.

	AM146	A1
Min age obtaining license	16	16
Max motor size cc	50	125
Mandatory training hours	10	11
4-level training including assessment	Yes	Yes
Theoretical test	Yes	Yes
Practical test	No	Yes
Number of learner riders allowed to teach in one group	3	1

2. Method

We selected a qualitative approach for this study because we explored a topic that is little investigated in scientific research. Thus, to know more from those working close to the group we wanted to gain more knowledge about, we wanted a rather broad and deep explanation in this initiating phase. The results of the current study are based on 10 semi-structured individual interviews with 10 informants. This study is part of a larger project on the understanding of risk and behavior and rider training for PTWs and is reported to the Norwegian Centre for Research Data.

2.1 *Participants*

For this study, ten informants were chosen because of their relevance (Kvale, 1996). It was for instance considered how much experience the instructors had in teaching rider learners of PTW's in addition to a geographical diversity in Norway. The informants were either lecturers at the university who educate PTW-rider instructors (three informants) or well experienced driver instructors who train two-wheel riders at driving schools (seven informants). The seven

participants who were PTW-instructors all came from different driver schools and were distributed in different parts of Norway.

2.2 *Interviews*

The 10 interviews were conducted over two months and were based on either telephone or face to face, according to the preferences of the informants. They lasted approximately one hour each. All interviews were conducted individually with only the informant and interviewers present. The interviews were recorded and transcribed.

In this project, the interview guides were semi-structured (Kvale, 1996), which implies that they contained open-ended questions that allowed the informants to talk freely. The interviews were divided into different topics, including general questions concerning the driver school, the work process, the training process, concerns during the training process, and the perceptions of the rider instructors of elements concerning the different driver training systems for PTWs.

2.3 *Analysis*

Thematic analysis was used to analyze the data. Nvivo 12, which is a software program, was used to organize our analysis of the transcribed material into categories. Thematic analysis offers a theoretical and flexible approach to analyze themes found in interviews (Braun & Clarke, 2006; Aronson, 1994). Themes related to training for the classes AM146 moped and A1 light motorcycle were prioritized in the coding. The first round of coding was broader before categories could be developed into themes. The theme development process was guided by the interview material rather than theory-driven.

3. Result

Regarding exploring risk factors in PTW rider training with a focus on AM146 (moped) and A1 (light motorcycle), our findings were the categories: (1) the number of learner riders, (2) course thinking, (3) evaluation criteria, and (4) economy.

Table 2. Factors related to risk in the rider training system

Factors related to risk in rider training	Illustrative quotes
1 the number of learner riders	"You do not get the same approach (with three) as one to one"
2 course thinking	"Many schools think of it as a course"
3 evaluation criteria	"There should have been a driving examination after level 4 prior to obtaining a license".
4 economy	"It is the competition and pricing that make you scared that you are too strict and that they do not return"

1 The number of learner riders. There is consensus between the informants that having three learner riders in a group in safety course in level 3 and 4 for the class AM146, moped, is a safety challenge. It is a challenge because of dangerous situations that might occur when driving in real life traffic such as one learner rider going over a road section, while others are left behind because of red lights. This is possible because the way this is trained is by the instructor to have contact with the learner riders through an intercom, all at the same time. Often one learner rider is first, and the instructor second in line. This is the learner rider in focus at this time. The two other learner riders are situated behind the instructor in a line, and the instructor does not have visual view of these two. Examples of quotes are: "the most demanding situation to work with is the moped pupils […] and they should really have been those to teach one on one". "The system is designed so that one teaches as many as possible"

Regarding the A1 class where three learner riders are not allowed, teaching each learner rider individually is preferred. The informants state that they are more in control of the situation with one as opposed to three learner riders, as this quote illustrates: "You do not get the same approach (with three) as one to one".

2 Course thinking. The phenomenon of course thinking relates to how pupils and some driving schools relate to marketing of the license. Informants state that this is a challenge in the industry as the curricula states that is should be individual training, but that 3 learner riders and mandatory hours gives an impression that it is a course one is taking, and that the minimum requirements are sufficient. Some driving schools even marked the rider training for AM146 as a

package with the minimum requirements for a set price, indicating that this will be adequate training for obtaining the license. A quote that illustrates this is for instance; "Many schools think of it as a course"

3 Evaluation criteria is the factor concerning how instructors evaluate the learner riders to pass the next level in addition to the final testing for obtaining the license. The informants for instance, did not mention that they base their evaluations of the learner riders' skills neither on the regulations nor curricula when explaining the process of level assessment. However, they did mentioned their own opinion and experience in regard to how they assess the learner rider's skills. In regard to the final testing, for the class of AM146, moped, the test is a theoretical test only. For A1 there is both a theoretical and a practical test that need to be passed. Quote examples are " I try to explain it to them … I hope I reach many with my views" and "There should have been a driving examination after level 4 prior to obtaining a license".

4 Economy is a client-based related factor. Completing rider training and obtaining a license is expensive, and driving schools are in competition with each other. The schools who have the less costly offer are often what is chosen by customers, but these do not necessarily offer the best quality training, according to our informants. A quote that illustrates this is "It is the competition and pricing that make you scared that you are too strict and that they do not return"

4. Discussion

In this study, we wanted to explore how the rider training industry saw the training system regarding risk factors for young riders. Thus, the research question was: *How could the high accident rate for younger drivers on two-wheelers be related to the rider training system?*

Our findings were the categories: (1) the number of learner riders, (2) course thinking (3) economy, and (4) evaluation criteria. It was broad agreement between the informants on these topics, and they were mentioned directly or indirectly by all.

Norway is ranked top when it comes to road safety (ETSC, 2016), hence, a lot is done right from a safety perspective. However, even here the numbers of serious accidents for PTWs and particularly for younger riders, are disquieting. The findings from this study recognize some factors regarding the rider training that the industry itself experiences as risk promoting.

The findings could be seen in relation to Rasmussen's (1997) theory of mitigation towards boundaries. Even though Jens Rasmussen mainly worked with major accident prevention (Le Coze, 2015), his ideas can be reflected upon in road traffic safety too. The boundaries his theory relates to are: acceptable performance, workload, and financial failure. It could be argued that in relation to road traffic and rider training, acceptable performance could relate to the operator, or the rider in this case. Thus, how does the quality of the training reflect the competence of the rider? Workload could be related to the instructor, as for instance teaching three learner riders in the complexity of real traffic at the same time, the workload could be viewed as mitigating to the boundary. Third, if the driving school does not have learner riders (and learner drivers), it could end in financial failure. We will come back to this last part of the discussion more thoroughly.

In regard to the first category found, the number of learner riders, it seems related to both the operator or rider level and the instructor level. The number of learner riders for AM146 are as many as three at the same time in real life traffic. This is a stressful situation for the instructor, and she/he must be alert at all times and is responsible for three learner riders in a complex context that is of high risk. Additionally, by this time they have not had many hours of practice or teaching and are fairly new to the situation. Thus, this category might relate to the mental workload the instructor has in these situations which might lead to a mitigation toward the boundary.

Regarding the second category, course thinking, it could be seen that the way schools organize the training, is within the law and legal requirements, but still balancing on a boundary of financial failure, as the customers seem not to be willing to pay more for hours. A consequence of this could result in instructors accepting learner riders to proceed to the next level and perhaps not have had sufficient individual training and thus skills. Reasons for this could be both economic or it could be questioned whether the instructor have sufficient knowledge of the rider learner to evaluate correctly from so few hours.

Thus, competition might lead the management and planning to relate to the attempts to adapt to the competitive environment. A basic problem, according to Rasmussen (1997), is that one violation of the boundary might not have a visible or immediate effect. So even though schools offer what resembles courses, as one of the result categories stated, in most cases this is not visible in the accident statistics. In regard to defense in depth, elements such as our current findings could be described as latent errors (Reason, 1990), This is because rider training is not evaluated as a direct cause of accidents and that errors occurring during training probably will not show directly. Further, the training system is a result of the curriculum and legal requirements made by actors that are not a part of a day to day operation. The actions of the rider in a given situation, on the other hand, will be defined as an active error. An

accident could thus be caused by rider training situation as a latent factor in addition to other factors.

In regard to the third category, evaluation criteria, it was interpreted that when the instructors talked about assessment of learner riders, they made their mandatory assessment based on their own experience and skills rather than based on regulations and curricula. It could be discussed whether a consequence of this could thus be that the goal achievements based on regulations are not necessarily met. Further, if comparing road traffic training to training for other high-risk contexts one sees that in industries such as surgery, piloting and so forth, the training need is something the organization often invests in and hires people with grades reflecting good skills. Here, as the third result category, stated, there is no practical evaluation of whether the candidate is adequately skilled, only a theoretical test for AM146 to obtain a license. This could thus be a challenge. What operators in high risk industries train for is something they work on with others and reflect upon on a regular and daily basis. This is not how it works for road traffic. After obtaining a license, the rider is on her or his own in a regulated context cooperating with other road users but not talking or reflecting with them. This occurs after 10 or 11 mandatory hours and for AM146 only a theoretical test, often for a 16-year-old, to prove one's level of competence. This might be because driving is seen as something needed in society and something "everyone" is allowed to master. Therefore, the society accepts the risk associated with driving because it is a necessary aspect of a modern society. The economy, that is the fourth category, could be related to this. It could seem that the demands for skills are lower in this high-risk context than most others. The competition and pricing seem in accordance with this availability aspect. In a society and in real-life situations, a large degree of freedom is left to the human (Rasmussen, 1997). Further, acceptable level of risk leads to a consequence of seeing a certain level of accidents as normal because of the degree of self-regulation and degree of freedom of local agents as riders (Rasmussen, 1997; Perrow, 1999). The context of road traffic in society, the level between the authorities with inspection and the operator is missing. In organizations, this level consists of managers and organizational rules and norms, that helps keep a focus on safety. Perhaps therefore, rider training should have more focus so that they are better at what they do prior to being in real life traffic on their own, making individual decisions. Still, this is a discussion concerning the price of obtaining a license that is available for the majority of the public versus the accepted level of safety and risk.

4.1 *Validity*

Validity should be part of the discussion in every qualitative study, (Kvale, 1996; Yardley, 2000). In qualitative research, generalization and the idea that other researchers will have the same findings are not the core idea. Instead, validity and transparency are important aspects. By using thematic analysis, which involves interpretation of what other people have said or done, the same set of data could end up with different results. This also implies that the use of thematic analysis could make it difficult to detect or prevent researcher-induced bias. For this reason, detailed descriptions are given of the theoretical context as well as the context of interviews, the method, and how the analysis and results were grounded in the data. This was done to provide transparency of the scientific process which is beneficial for the validity (Yardley, 2000). Further, as a scientist, one is never sure if the informant is telling the truth, telling what he or she thinks the scientist is interested in hearing, or what they think the management wants to hear. However, when speaking to the informants who worked in different driving schools in different parts of Norway, they seemed to have a rather similar perception of the theme, and the questions were open. This could indicate that it was not a form of group think among the informants. We tried to be as open as possible during the interviews, with open questions to prevent the informants to feel that we somehow wanted preset answers from them or tell us what we were interested in hearing.

4.2 *Implications*

This research will be useful for further work on development of curricula and rider instructor education in Norway and Europe. Training is a factor that has not been much explored scientifically, and research concerning this could contribute to a more optimal training system. This aspect concerns both the amount of training but also just as important, the quality of the content. The findings in the current paper could also contribute to European development of rider training.

4.3 *Further research*

In Europe there is a trend of an increase in the numbers of PTWs. This could be beneficial for instance for environmental aspects such as queuing and mobility, however, it also will give larger degree of exposure as the number of riders increases and could thus result in higher accident rates. Therefore, it is important to gain deeper knowledge of the license class' risk elements regarding for instance the curricula, the rider instructors, aspects of the riders' age, marked

forces, and so forth. In the future, more research is considered beneficial for these themes, for instance exploring more in depth which qualifications the trainer needs.

5. Conclusion

Even though Norway is one of the safest countries regarding road traffic (ETCS, 2016), there are elements that could be associated with risk in the rider training system that is operated in Norway today. The factors revealed in this study were (1) the number of learner riders, (2) course thinking (3) economy, and (4) evaluation criteria. It seems the discussion on whether these are factors that should be dealt with are within the axis of production versus safety. Accident numbers for younger riders in Norway and Europe in general are high, and a better understanding of sufficient and more optimal training could contribute to safer riding.

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