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Introducing accompanied driving in Denmark. Safety-related differences between youth licensing with immediate or delayed access to solo driving

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ABSTRACT

In Denmark, the legal license age was lowered from 18 to 17, to allow practice with an experienced driver before solo driving from age 18. The change gives the candidate driver a choice between: a) licensing at age 17 followed by a phase of accompanied driving until solo driving at age 18 (L17), and b) licensing at age 18 (or older) giving immediate access to solo driving (L18). The purpose of this study is: First, to explore safety-related differences between youth choosing the L17 or the L18 option, with a particular focus on safety attitude and self-assessed driving skills. Second, to map patterns in the use of accompanied driving and its predictors as well as the interaction between the L17 driver and the accompanying person (ACP).

A sample of 632 drivers (53% male) between 17 and 19 years of age completed a survey. Among the participants 61% licensed through L17 and 39% through L18. Our results identify different risk profiles between L17 and L18. A higher score on perceptual-motor skills, lower score on safety skills and lower support to speed limits predicted L17. Female L17 were more safety-oriented compared to male L17. L17 who had experienced a supportive atmosphere and engagement in complex traffic situations during the drive were more likely to indicate that accompanied driving had improved their driving skills. However, results also indicate that the amount of experience obtained by L17 may be insufficient to obtain a safety benefit.

Measures to address speeding and other risk-taking behaviours among male candidate drivers are needed to ensure a safety benefit of the Danish accompanied driving scheme. In addition, requirements may be needed to increase the amount of accompanied driving. Finally, parent guidelines could support the creation of a positive atmosphere during the drive.

1. Introduction

Young drivers, particularly young male drivers, continue to be overrepresented in road traffic crashes (e.g. Elvik., 2010; Scott-Parker et al., 2020) and road crashes are still the prime cause of death among adolescents (WHO, 2018). In Denmark, the risk of being killed or seriously injured for an 18 year old driver is 12 times higher compared to a driver aged 44 (Christiansen and Warnecke, 2018). The high risk for young drivers is the result of a combination of age- and experience-related factors (OECD, 2006). To improve young driver safety, Denmark lowered the legal licensing age from 18 to 17 to create a time window for practice with an experienced driver before access to solo driving from age 18. This change gives the candidate driver a choice between licensing with delayed or immediate access to solo driving: a) licensing at age 17 followed by a phase of accompanied driving until solo driving at age 18 (L17), and b) licensing at age 18 (or older) giving immediate access to solo driving with no restrictions (L18). The purpose of the present study is twofold. First, to explore safety-related differences between youth choosing the L17 or the L18 option, with a particular focus on safety attitude and self-assessed driving skills. Second, to map patterns in the use of accompanied driving and its predictors as well as the interaction between the L17 driver and the accompanying person (ACP) during the drive. This information is essential for identifying adjustments needed to achieve the intended safety effect of L17.

1.1. Delayed (L17) or immediate (L18) access to solo driving

In Denmark, all pre-license training must be obtained at a driving

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school and with a professional driving instructor. A candidate driver can enroll at a driving school three months before turning 17 at the earliest. A full license can only be obtained after passing the national practical and theoretical test. The test standards are the same regardless of the age of the candidate driver. If the candidate is 18 (L18) when passing the tests solo driving is allowed immediately with no restrictions. If the candidate is 17 (L17) when passing the tests the candidate must be accompanied by an experienced driver until solo driving is allowed at age 18. No requirements regarding the amount or type of accompanied driving exist and no registration of any kind is required. Once an L17 age 18. No requirements regarding the amount or type of accompanied driving exist and no registration of any kind is required. Once an L17 driver turns 18, solo driving is automatically allowed, without any restrictions. The ACP needs to be at least 30 years of age and to have possessed a Danish driver’s license for the last 10 years, without disqualifications. The ACP is not allowed to be impaired in any way during the drive. It is the responsibility of the L17 driver to ensure, that the ACP fulfills the requirements.

These changes in the licensing scheme are based on the assumption that compared to L18 drivers, L17 drivers will drive more safely and have fewer crashes due to an expected extra driving experience before solo driving. Studies show that crash risk decreases with increasing driving experience (Mayhew et al., 2003; OECD, 2006). Driving performance studies show that the required skills for safe driving develop at different paces. Lower order skills such as vehicle control are mastered early in the learning process whereas higher-order skills, such as hazard perception require far more practice (Borowski et al., 2013; Deery, 1999; Laapotti et al., 2001; Hatakka et al., 2002), specifically the perception of latent hazards (Vlakveld et al., 2011; Abele et al., 2019) and situation awareness (De Craen et al., 2008; Scott-Parker et al., 2020). These higher order skills also require exposure to a mixture of traffic situations of varying complexity (Ehsani et al., 2017), a requirement that often cannot be met in professional instruction. For instance, candidate drivers who train in the summer period, will get less experience of driving in darkness or on icy roads, both conditions known to increase crash risk (Clarke et al., 2006; Duddo et al., 2019). It is therefore expected that accompanied driving will provide additional practice in more diverse conditions than professional training can do. So far, only few studies have tested that.

1.2. Potential impact on safety

Although it is expected that extra experience will be obtained and will be beneficial, L17 also implies possible detrimental effects of early licensing, by increasing access to solo driving at a younger age. Studies show young age to be associated with higher crash rates and riskier driving. This elevated risk is not due to a lack of technical skills, but to motivations and biological immaturity as adolescence is a period characterised by poor impulse control, high sensitivity to peer pressure, and sensation seeking (Reyna and Farley, 2006; Bingham et al., 2008). Driving is then used for self-enhancement and engagement in risk-taking behaviours as part of developmental needs (Hatakka et al., 2002). In a negative scenario, these characteristics may offset the benefits from the extra experience, whereas in a positive scenario the extra experience may protect young drivers despite their psychological vulnerability.

1.3. Practice, driver type, and parental support affecting impact of L17

Existing evidence from supervised driving indicates that the amount and type of driving, characteristics of the participating young drivers and parental support are crucial for the obtained safety effect. The safety benefit of supervised practice generally increases with the number of hours and duration of the period but the optimal amount has not yet been conclusively established (Chapman et al., 2014; Senserrick et al., 2021; Williams, 2017). Between 6 and 12 months and 50–70 h are commonly required (Williams, 2017). In Queensland, Australia, the requirement is 100 h (Senserrick et al., 2021). Results from accompanied driving in Germany and the Netherlands provide further support for the importance of the amount and duration of the driving period. In the case of Germany it was found that young drivers who licensed at age 17 to engage in accompanied driving had 19% fewer crashes during the first year of solo driving compared to drivers who licensed at age 18 with immediate access to solo driving. In Germany, the average duration of accompanied driving was 6.6 months, three drives per week and an average of 2400 km in total (Schade and Heinzmann, 2013). In the Netherlands, the level of practice was lower, with an average of just two trips a week and a total of 1700 km (Schagen et al., 2015). Significant effects on crash involvement were not identified (Schagen and de Craen, 2015). However, due to methodological differences, a cross country comparison of these results is problematic and additional studies are needed to assess the association between the actual levels of accompanied driving and the associated safety effects. Regarding the type of driving situations, evidence indicates that the driving should include a multitude of traffic situations of varying complexity (Tronsmoen, 2011; Ehsani et al., 2017). In addition, parental support and a positive interaction and atmosphere between the young driver and the supervisor is associated with a larger amount of supervised driving, compliance with the requirements and subsequent safe behaviours (e.g. Brookland et al., 2014; Mirman et al., 2014; Taubman Ben-Ari, 2010).

Driver characteristics such as gender and attitude towards safety are associated with engagement in risk-taking behaviours. Compared to young women, young men are less concerned about crash risk (Cordellier et al., 2016), take more risks (Barr et al., 2015; Oviedo-Trespalacios and Scott-Parker, 2018), and score higher on sensation seeking (Oppenheim et al., 2016). Compared to young female drivers, young male drivers are also overrepresented in crashes (Moller and Janstrup, 2021; Twisk and Stacey, 2007). Further, a positive attitude towards risk-taking behaviour is associated with increased engagement in risk-taking behaviour (Davey et al., 2005; Ledesma et al., 2018; Sheeran et al., 2016; Stephens et al., 2017). To understand the effect of L17 in relation to L18, knowledge about the type of young drivers attracted to the L17 option is crucial, and provides opportunities to tailor the L17 option to their specific needs. The results from the Netherlands already indicate that young people enrolled in the Dutch L17 scheme scored high on risk-taking and speeding (Schagen and de Craen, 2015). In addition, increased confidence as a driver may motivate increased engagement in risk-taking behaviour (Elvik et al., 2009). Such potential adverse effects of accompanied driving may be reinforced by the negative effect of early licensing (OECD, 2006; Twisk and Stacey, 2007). Results from pre-license supervised driving show that when solo driving is initiated crash rates become three to seven times higher with the youngest drivers having the highest crash rate (Chapman et al., 2014).

In addition to skills and individual differences, safety is also influenced by exposure (Elvik, 2015). Previous studies show that living outside urban areas (e.g. Delbosc and Currie, 2014; LeVine and Polak, 2014; Shults and Williams, 2013; Tefft et al., 2014; Zhao and Bai, 2019), and limited access to alternative travel modes (Delbosc et al., 2019; Smart and Klein, 2018) increase the likelihood of early licensing. Young people’s car use is also known to be influenced by the level of urbanization of their neighborhood (Melia et al 2018) as well as the car use of their parents and peers (Sigrúnardóttir et al., 2013; Sigrúnardóttir et al., 2014). Thus, knowing if young people living in rural areas and coming from car-oriented environments are more likely to choose the L17 option is relevant as this may be associated to increased exposure to solo driving at age 18. To date, these aspects, relevant for the safety impact of L17 versus L18 have not yet been explored.

1.4. Study approach

Based on the above, the purpose of this study is twofold: First, to explore safety-related differences between youth choosing the L17 or the L18 option with a particular focus on safety attitude and self-assessed driving skills. Second, to map patterns in the use of accompanied driving and its predictors as well as the interaction between the L17
driver and the ACP during the drive. We expect youth choosing the L17 option to be more enthusiastic about driving, to have a weaker safety-oriented attitude, and to come more often from rural areas and car-oriented environments than youth choosing the L18 option. In addition, we expect that the amount of accompanied driving contributes to improvements in self-assessed driving skills, and that these are influenced by the characteristics of the driving experience and by the interactions with the ACP. We check for possible gender effects for both purposes. To test these expectations, 18 and 19 year-olds in possession of a Danish driving license were recruited to complete a survey.

2. Method

2.1. Data collection and participants

Data were collected by a survey conducted by the market research institute EPINION between August 2018 and April 2019. The sample included 632 young drivers (53% male). Among the participants 388 (61%) got licensed at age 17 (L17) and 244 (39%) at age 18 (L18). At the time of the survey 29 (5%) were 17 years old, 411 (65%) were 18 years old, and 192 (30%) were 19 years old. No ethical approval was needed for the study. Data were collected and stored according to the GDPR-regulations.

Participants were recruited in two ways. First, 135 young drivers were recruited among participants in the Danish National Travel Survey. They completed the survey online or as a telephone interview. Inclusion criteria were possessing a driver’s license and being born between January 1, 1999 and December 31, 2000 to ensure that they had had the possibility to choose between the L17 and L18 option. Incomplete responses from 32 persons were excluded from the analysis. In total, responses from 103 persons recruited among National Travel Survey Participants were included. Second, 529 young drivers were recruited from a representative gross sample of 10,000 people born October 1999 - December 2000. The gross sample was obtained from the official Danish population register. Young people who did not hold a driver’s license were screened out. The survey was completed as a telephone interview using a cold-calling procedure. (See Fig. A.1 in Appendix A for an overview of the methodological steps).

2.2. Measures

The questionnaire included items on demography, attitude towards road safety and daily transport, self-assessed driving skills, and experiences with accompanied driving. The items about experiences with accompanied driving were only included for L17. All other items were included for both L17 and L18.

Demography: age, gender, primary occupation and area of residence, moped license, and licensing age (“17”, “18”). Participants indicated how important different aspects were for licensing at that time (3-point scale from “not important at all” to “very important”) and their access to public transport (3-point scale from “good” to “bad”). They also indicated how often their parents drove a car and used public transport (5-point scale from “never” to “very often”). The 5-point scale was transformed into a binary variable (never/rarely” /”often”).

Attitudes towards road safety: Participants indicated on a 5-point scale (from “strongly disagree” to “strongly agree”) how much they agreed with 10 statements developed in a previous study (Møller & Haustein, 2014). A factor analysis with Varimax rotation revealed a three-factor solution: General safety attitude, Attitude towards speed limits, attitude towards penalties for road traffic violations. Cronbach’s alpha was 0.70. All items had factor loadings above 0.45 and explained 53% of the variance.

Attitude towards daily transport: On a 3-point scale (from “low importance” to “high importance”) participants indicated the degree to which 11 aspects were important for their satisfaction with daily transport. The individual items were developed in a previous study (Sigurðardóttir, 2013). A factor analysis with Varimax rotation revealed a three-factor solution. Cronbach’s alpha was 0.68. All items had factor loadings above 0.45, and explained 50% of the variance. For each factor a mean scale was constructed. We labelled the scales: Independence, Health, and Safety.

Self-assessed driving skills: Using a Danish version (Martinussen et al., 2014) of the Driver Skill Inventory (DSI), participants rated their driving skills on a 5-point scale from “well below average” to “well above average”. A factor analysis with Varimax rotation confirmed the original two-factor solution (Lajunen & Summala, 1995): Perceptual-motor skills and safety skills. 48% of the variance was explained. Cronbach’s alpha was 0.92, and all items had loadings above 0.45.

Mapping of accompanied driving was done based on several measures. Participants identified their relation to their main ACP (e.g. parent, friend). Average number of trips per week, duration in months, and average number of km per trip were used to measure the amount of accompanied driving. Participants also indicated how important different aspects were for the amount of accompanied driving (5-point scale from “not important at all” to “very important”), whether they were satisfied with the amount and whether they believed that it had improved their driving skills (5-point scale from “no” to “yes, to a very high degree”). The 5-point scale was transformed into a binary variable (“little or no”/”yes, to a very high degree”). In addition, participants indicated if they had driven a car at the age of 17 without an ACP (“yes”, “no”) and if their friends had done so (“yes”, “no”, “don’t know”).

The type of accompanied driving was measured on a 3-point scale. Participants indicated to which degree (from “low degree” to “high degree”) accompanied driving had included 17 different traffic situations. A factor analysis with Varimax rotation revealed a three-factor solution: Technical manoeuvres, Complex traffic situations, and Challenging driving conditions. Cronbach’s alpha was 0.86, all items had factor loadings above 0.44, and the solution explained 52.2% of the variance. Participants also indicated where the accompanied driving mostly took place (on familiar locations, both on familiar and unfamiliar locations, on unfamiliar locations), and what characterized the trips (“mostly trips that would take place anyway”, “mostly trips with a training purpose”, “equal proportion of trips that would take place anyway and trips with a training purpose”).

The interaction between the young driver and ACP was measured in three ways. The emotional climate during the drive and the attitude of the ACP were measured by a 3-point scale (from “a low degree” to “a high degree”). Eight items addressed the emotional climate during the drive (e.g. fun, distracting). A factor analysis with Varimax rotation revealed a two-factor solution: hostile atmosphere, and positive atmosphere. All items had factor loadings above 0.69 and Cronbach’s alpha was 0.73. The solution explained 52.2% of the variance. Nine items addressed the attitude of the ACP during the drive (e.g. friendly, aggressive). A factor analysis with Varimax rotation revealed a two-factor solution indicating a supportive ACP and non-supportive ACP attitude. The solution explained 55.8% of the variance, and Cronbach’s alpha was 0.82 with a factor loading above 0.51 for all items. Feedback about driving behaviour from ACP to the young driver was measured by three options (“yes, during the drive”, “yes, after the drive”, “no”).

2.3. Analysis

The significance level was set to $p < 0.05$ in all analysis. We used a $\chi^2$-test to test whether L17 and L18 were representative with regard to gender, area of residence, and licensing age of the corresponding group in the population, based on information from Statistics Denmark and the Danish license register. With regard to area of residence we defined five geographical areas: 1) The three largest cities, 2) the six second largest cities, 3) Zealand, 4) Funen & Bornholm and 5) Jutland (Fig. 1).

Group 1 and 2 include large urban areas, while the remaining groups represent more rural areas. Our sample is representative with regard to gender and area of residence, but has a minor overrepresentation of
people licensed through L17 (61% compared to 50% in the population) (p < 0.01).

To identify differences between L17 and L18, we used χ²-tests in relation to demography, and t-tests to test for differences in mean score for attitude towards road safety, self-assessed skills, and transport mode. The same tests were applied to test for gender differences in the whole sample. We conducted a logistic regression with maximum likelihood estimation to model the likelihood that the participants had licensed at 17. Demographics, attitude towards road safety and transport mode, self-assessed driving skills were included as predictors. For significant variables different interaction terms were tested as well. Correlation between the predictors were identified by the Pearson correlation matrix. If no high correlation (r < 0.70) between predictors were identified non-significant predictors were removed from the logistic regression if it improved the Akaike information criterion (AIC). If high correlation were revealed between two predictors (r ≥ 0.70) and only one of them were significant in the logistic regression model both were included in the final model. The model was evaluated by the Hosmer and Lemeshow Goodness-of-fit.

To map patterns in the use of accompanied driving a number of analysis were applied. To calculate the amount of driving, we converted the self-reported weekly driving frequency to an average monthly number of trips (“Daily”=30, “4-6 times a week”=21, “1-3 times a week”=9, “1-3 times a month”=2, “Less often”=0.5), which we multiplied by the number of months driven. We tested how the variables “Wish to improve driving skills”, “Wish to drive”, “Car access”, “Availability of ACP”, “Parent’s attitude”, “Time (ACP)”, “Time (my own)”, “Turned 18 shortly after” and “Friend’s attitude” influenced the amount of accompanied driving, by testing differences in the mean score using t-tests. All variables were tested for gender differences through χ²-tests and t-test.

We used χ²-tests to identify differences regarding demography, exposure to different traffic situations, amount and duration of accompanied driving and for self-assessed improvement in driving skills due to accompanied driving. Furthermore, we used t-test to identify differences in the mean score for type of driving situations, and the emotional climate and atmosphere during the drive between participants who indicated that accompanied driving had improved their driving skills and those who had not. A logistic regression model estimated the likelihood that accompanied driving had improved self-assessed driving skills. Demographics, ACP, amount of accompanied driving, and satisfaction with the amount, type of situations included, and the emotional climate and atmosphere during the drive were included as predictors. The Pearson correlation matrix was calculated to identify correlation between predictors included in the regression. If only low correlation (r < 0.70) between the predictors were identified non-significant predictors were removed from the logistic regression if it improved the AIC. If high correlation was identified between two predictors (r ≥ 0.70) and only one of them was significant in the logistic regression both were included in the final model. The final model was evaluated using the Hosmer and Lemeshow Goodness-of-fit.

3. Results

In this section, we first present results regarding differences between people choosing the L17 or the L18 option. Second, we present results about the use of accompanied driving and its predictors for L17.

3.1. Aspects predicting L17

When comparing participants licensing at age 17 (L17) and at age 18 (L18), we found significant differences regarding gender, area of residence, access to public transport, parents’ transport behaviour and aspects influencing the decision to license (see Appendix A, Table A.1 for an overview). Compared to L18, the following proportions were higher among L17: female, people living in the rural area Jutland, people with mothers who frequently drive cars, and people for whom “wanting to drive” was very important for their decision to license. In contrast, the following proportions were lower among L17: parents often using public transport and having good access to public transport. On attitudinal factors and self-assessed skills, L17’s score higher on general safety, perceptual-motor skills and they support penalties for traffic violations.
more (Table 1).

To examine the independent effect of the different aspects on the choice for L17 vs L18, we conducted a logistic regression analysis. The Pearson correlation matrix revealed a high correlation \((r = 0.60)\) between safety skills and perceptual-motor skills, while a correlation below \([0.31]\) was observed between the remaining predictors. Interaction terms between gender, attitudes and driving skills factors were not significant at a 5% level and therefore not included in the final model (Table 2).

Results show that the odds of licensing at 17 are higher for female than male \((OR = 1.83)\) participants and if the mother “never/rarely” uses public transport compared to “often” using public transport \((OR = 2.60)\). At the same time drivers licensing at 17 have higher odds of a higher score on general attitude towards safety \((OR = 1.85)\) and perceptual-motor skills \((OR = 1.71)\). In contrast, the odds decrease with higher scores on support for speed limits \((OR = 0.66)\) and perceived safety skills \((OR = 0.66)\). These effects are significant even when controlling for geography (at the regional level).

3.2. Amount of accompanied driving

To estimate the amount of accompanied driving only L17 were included \((N = 388)\). A total of 51 respondents were excluded from this analysis for the following reasons: the respondent reported a very high average trip length \((>100 \text{ km})\) \((N = 13)\), the respondent reported a number of months driven exceeding by more than one the number of months since licensing \((N = 9)\), or the respondent was younger than 18 at the time of the survey \((N = 29)\). This resulted in 87% \((N = 337)\) of the initial sample to be included in this calculation. Some assumptions were made regarding some of the respondents: the number of months driven was set to 0 if the respondent had not engaged in accompanied driving at all \((N = 15)\), the number of months was set to 0.5 if drivers had engaged in accompanied driving for less than one month \((N = 29)\). Among the 337 the majority \((N = 272, 81\%)\) drove with an ACP at least once a week. 41% had engaged in accompanied driving for 3 months or less, 31% for 4–6 months, and 28% for 7 months or more. Based on self-reported trip lengths, the average trip was 23 km. The median was 20 km. On the basis of these estimates the results show that 25% of the young drivers had driven \(<400 \text{ km}, 50\% <1060 \text{ km} \text{ and } 75\% <1680 \text{ km} \text{ while accompanied by an ACP.}

3.3. User experience and engagement in accompanied driving

For the remaining analysis all L17 respondents are included except for respondents that had not engaged in accompanied driving at all \((N = 15, 4\%)\) as these could not provide relevant information about their experiences with accompanied driving. The analysis is therefore based on 96% \((N = 373)\). The accompanied driving trips mostly occurred on familiar locations \((N = 210, 56\%)\), and included drives that were to be driven anyway such as daily commutes \((N = 234, 63\%)\). The majority were satisfied with the amount of accompanied driving \((N = 325, 87\%)\). Parents were the main ACP \((N = 351, 94\%)\) and most received feedback from the ACP during the drive \((N = 287, 77\%)\). The majority indicated that they had not engaged in illegal unaccompanied driving themselves \((N = 311, 83\%)\), but the majority had friends who had done so \((N = 218, 58\%)\). Regarding variables influencing the amount of accompanied driving, “Wish to improve driving skills” and “Wish to drive” were the most important factors, whereas “Friends’ attitude towards accompanied driving” was the least important factor. Fig. 2 shows the answers, split by the reported frequency of accompanied driving. Regarding “Wish to improve driving skills”, “Wish to drive”, “Car access”, and “Availability of ACP”, “Parent’s attitude” and “Time (ACP)” the mean score was significantly higher for those who engaged in accompanied driving at least once a week compared to those with a lower frequency of accompanied driving.

To see if some aspects were more likely to be associated with male than female L17, we conducted a \(\chi^2\)-test and \(t\)-test (See Appendix A, Table A2, A3, A4), but only a few variables were significant. More male L17 had a moped license \((p < 0.01)\), a father who never or rarely drove a car \((p = 0.01)\), and had engaged in unaccompanied driving \((p < 0.01)\) compared to female L17. Regarding aspects influencing the amount of accompanied driving “Wish to drive” was the most important factor whereas “Friends’ attitude” was the least important. However, the mean score on both variables was higher for male L17 compared to female L17. For attitudinal factors female L17 scored higher on general safety \((p = 0.02)\), agreement with the current speed limits \((p < 0.01)\), penalty for traffic violations \((p < 0.01)\), and “safety” \((p = 0.02)\) as important for daily transport. In addition, female L17 scored higher on safety skills \((p < 0.01)\) but lower on perceived-motor skills compared to male L17. Regarding experiences with engagement in accompanied driving only two gender differences were identified. Female L17 scored higher on the atmosphere being negative during the drive, and indicated that practising technical manoeuvres was included to a higher degree compared to male L17.

### Table 1

| Factors | L17 Mean | SD | L18 Mean | SD | \(t\)-test, \(p\)-value |
|---------|---------|---|---------|---|-------------------|
| Attitude towards road safety* | 4.63 | 0.51 | 4.48 | 0.61 | \(<0.01\) |
| Speed limits | 3.81 | 0.90 | 3.92 | 0.91 | 0.13 |
| Penalties | 3.57 | 0.93 | 3.42 | 0.93 | 0.04 |
| Attitude towards daily transport*b | 2.34 | 0.56 | 2.27 | 0.56 | 0.14 |
| Health | 1.97 | 0.57 | 2.04 | 0.62 | 0.13 |
| Independence | 2.57 | 0.41 | 2.54 | 0.39 | 0.42 |
| Safety | 3.74 | 0.63 | 3.64 | 0.55 | 0.05 |
| Self-assessed skills* | 3.85 | 0.62 | 3.86 | 0.53 | 0.87 |

Note: * 5-point scale from “strongly disagree” to “strongly agree”, b 3-point scale from “low importance” to “high importance”, and c 5-point scale from “well below average” to “well above average”.

### Table 2

| Variable | Category | Est. | SE | \(p\)-value | OR | 95% CI |
|----------|----------|------|----|-------------|----|--------|
| Intercept |          | -3.20 | 0.94 | \(<0.01\) | - | - |
| Gender | Male | 0.61 | 0.18 | \(<0.01\) | 1.83 | 1.28-2.63 |
| Residence | Three largest cities | 0.53 | 0.32 | 0.10 | 1.69 | 0.90-3.17 |
| Safety skills | 0.66 | 0.44 | \(<0.01\) | 1.85 | 1.34-2.56 |
| Perceptual-motor skills | 0.53 | 0.19 | \(<0.01\) | 1.71 | 1.16-2.50 |
| Number of observations | 632 | 1.99 | \(<0.001\) | 48.64 | P-value (H0, \(\beta = 0\)) | 845.04 |
| Wald Chi-square | 10 | 1.00 | 0.99 | 0.45 | R-square | 0.08 |
| Degrees of freedom | 0.98 | 1.00 | 0.49 | 1.00 | Value | 1.00 |

Note: Wald Chi-square = \(\chi^2\)-test and \(t\)-test (See Appendix A, Table A2, A3, A4), but only a few variables were significant. More male L17 had a moped license \((p < 0.01)\), a father who never or rarely drove a car \((p = 0.01)\), and had engaged in unaccompanied driving \((p < 0.01)\) compared to female L17. Regarding aspects influencing the amount of accompanied driving “Wish to drive” was the most important factor whereas “Friends’ attitude” was the least important. However, the mean score on both variables was higher for male L17 compared to female L17. For attitudinal factors female L17 scored higher on general safety \((p = 0.02)\), agreement with the current speed limits \((p < 0.01)\), penalty for traffic violations \((p < 0.01)\), and “safety” \((p = 0.02)\) as important for daily transport. In addition, female L17 scored higher on safety skills \((p < 0.01)\) but lower on perceived-motor skills compared to male L17. Regarding experiences with engagement in accompanied driving only two gender differences were identified. Female L17 scored higher on the atmosphere being negative during the drive, and indicated that practising technical manoeuvres was included to a higher degree compared to male L17.
A small majority (N = 208, 56%) indicated that accompanied driving had improved their driving skills “to a high degree” (see Appendix A, Table A.5) for an overview of characteristics.

Table 3 shows that those L17s, who found that accompanied driving had improved their skills, scored higher on the inclusion of complex traffic situations, a positive atmosphere during the drive, a supportive attitude of the ACP, and on perceptual-motor skills and safety skills. In contrast, they scored lower on a non-supportive attitude of the ACP and a hostile atmosphere. However, only complex traffic situations and emotional climate became significant in the final model (Table 4).

Five variables and factors are significant and emotional climate is the strongest predictor of a self-assessed “high degree” of improvement in driving skills. The odds also increase if the young driver has compared to has not practiced specific manoeuvres or traffic situations (OR = 1.77).

Regarding the factors, the inclusion of complex traffic situations (OR = 1.61) and a positive atmosphere during the drive (OR = 8.71) also predict a “high degree” of self-assessed improvements in driving skills. A hostile atmosphere during the drive has the opposite effect (OR = 0.26).

For the duration in months, the likelihood of self-assessing a “high degree” of improvements in driving skills decreases with increasing duration (OR = 0.46) and (OR = 0.71).

4. Discussion

The purpose of this study was twofold. First, to identify possible differences between people choosing the L17 or the L18 license option, particularly regarding safety attitude and self-assessed driving skills. Second, to map patterns in the use of accompanied driving and the interaction between the young driver and the ACP during the drive.

To assess the participants’ safety attitudes and self-assessed driving skills we use factors previously applied in studies with Danish drivers. The Cronbach’s alpha values for the individual factors are comparable with those found in the previous studies (see Lajunen & Summala, 1995; Martinussen et al., 2014; Møller & Haustein, 2014). Our results identify differences in safety attitudes and self-assessed skills between L17 and L18. Specifically, the likelihood of having chosen the L17 option increases with a higher score on perceptual-motor skills which is known to be associated with engagement in risk-taking behaviours and crash risk (Ozkan and Lajunen, 2006). In contrast, the likelihood decreases with a higher score on safety skills and support to speed limits. Thus, results indicate that L17 may be more likely to engage in risk taking behaviours compared to L18 particularly with regard to speeding. Results from the Netherlands showing that accompanied driving participants have a preference for high speed (Schagen and de Craen, 2015) support this.

Table 3: Comparison of mean scores between L17 who indicated that accompanied driving had improved their driving skills to a “high degree” vs to a “low degree”/“not at all”.

| Factors               | Skills improved to a high degree | Skills improved to a small degree/not at all | t-test, p-value |
|-----------------------|----------------------------------|---------------------------------------------|----------------|
| Maneuvers/situations  | Technical maneuvers              | 2.12 0.60                                   | 2.04 0.56      | 0.20 |
|                       | Complex traffic situations       | 2.30 0.51                                   | 2.13 0.56      | <0.01|
|                       | Challenging conditions           | 1.93 0.52                                   | 1.87 0.51      | 0.28 |
| Emotional climate     | Positive atmosphere              | 2.69 0.33                                   | 2.23 0.55      | <0.01|
|                       | Hostile atmosphere               | 1.26 1.26                                   | 1.46 0.53      | <0.01|
|                       | Supportive ACP                  | 1.26 1.26                                   | 1.46 0.53      | <0.01|
|                       | Non-supportive ACP              | 2.75 0.35                                   | 2.54 0.52      | <0.01|
| Self-assessed skills  | Perceptual-motor skills          | 1.52 0.25                                   | 1.60 0.29      | <0.01|
|                       | Safety skills                    | 3.80 0.58                                   | 3.66 0.68      | 0.03 |
|                       |                                  | 3.90 0.60                                   | 3.77 0.64      | 0.04 |

Note: a 3-point scale from “a low degree” to “a high degree”. b 5-point scale from “well below average” to “well above average”. N = 373
interpretation. The preference for high speed is unfortunate, because youth associate speeding with advantages such as excitement and thrill and have a strong belief in their ability to control a motor vehicle at high speeds (e.g. Møller et al., 2021; Rowe et al., 2016). In addition, speeding is a key contributing factor in crashes among youth (Gonzales et al., 2005; Møller and Haustein, 2016) associated with age-related engagement in risk-taking behaviour rather than experience (Lam, 2003). Further, increased confidence as a driver is known to increase the motivation to engage in risk taking behaviour (Elvik et al., 2009). Altogether, the result indicates that youth choosing the L17 option are less safety oriented and may be more likely to engage in speeding behaviour compared to youth choosing the L18 option. However, we do not have information about pre-license safety attitudes. Therefore, it is unclear if more risky, driving-eager and over-confident youth is attracted to L17 because it provides the opportunity to drive early (accompanied) or accompanied driving increases over confidence which is unjustified because of the low number of kilometres driven. Never the less, the results indicate a need for targeted measures to prevent engagement in speeding among youth choosing to license early.

Related to this, our results indicate that measures addressing speeding behaviour are particularly relevant for male participants as we identified different risk profiles among male L17 and female L17. Female L17 seem more safety oriented and to be motivated by a transport related need for a driver’s license whereas male L17 are less safety-oriented and more confident about their perceptual-motor skills and motivated by an interest in motor vehicles indicated by an increased likelihood of holding a moped license. These differences could indicate that the well-known difference in risk-taking behaviour and crash risk between young male and female drivers (e.g. Barr et al., 2015; Cordellieri et al., 2016; Scott-Parker, 2018; Twisk and Stacey, 2007) could be enforced by the current Danish license scheme unless measures are taken to address it.

It is expected that the possibility to practise with an experienced driver before access to solo driving will increase safety among young drivers. However, our results indicate that the current scheme with no requirements regarding the amount or type of accompanied driving may not ensure this. On the contrary, our results indicate that the majority of the accompanied driving participants do not drive sufficiently to obtain the intended safety benefit. Although the optional amount of driving experience before solo driving has not yet been finally established the mean period of accompanied driving among the Danish L17 is below the 6–12 months often required for supervised driving (Williams, 2017). Similarly, with regards to kilometres driven our results indicate that the additional experience obtained among L17 is less than the 2000 km recommended in Austria, the 3000 km recommended in France and the 5000–7000 km recommended in Norway (OECD, 2006). With 75% of the Danish L17 driving<1680 km the additional experience is also smaller than the average total of 2400 km in Germany which was associated with a decrease in crash rate during the first year of solo driving (Schade and Heinzmann, 2013). These findings are consistent with previous studies showing that positive effects on driving performance or crashes were only observed with high number of accompanied driving hours for Sweden (Gregersen et al., 2000), France (Page et al., 2004), Germany (Schade and Heinzmann, 2013), Norway (Sagberg, 2002) and The Netherlands (Schagen and de Craen, 2015). It is crucial to mention, that our sample was too small to allow conclusions about crash risk, and additional studies focussing on crash involvement and driving experience among accompanied driving participants are therefore needed to verify these results. However, our results do indicate that allowing voluntary accompanied driving at age 17 with no mandatory requirements may have possible detrimental effect in two ways. First, if the additional experience obtained is insufficient to reduce crash risk, but sufficient to increase self-confidence as drivers it may enforce a motivation to engage in risk-taking behaviours as indicated by previous studies (Elvik et al., 2009). Second, due to the lack of requirements regarding accompanied driving people licensing at 17 have free access to solo driving at 18 even with no driving in between. As driving skills deteriorate rapidly when not being maintained, particularly among novice drivers (Upahita et al., 2018) this may increase crash risk for those L17 who do not engage in accompanied driving when they initiate solo driving. Our results indicate that the majority of L17 do engage in accompanied driving to some extent. However, additional studies exploring this are relevant.

A small majority of the participants indicated that participating in accompanied driving had improved their driving skills. No gender effect was found. The effect increased with practise of specific skills and engagement in complex traffic situations during accompanied driving. It could indicate, that the self-assessed improvements in driving skills not only include basic vehicle manoeuvrings skills but also more advanced driving skills such as hazard perception (Borowski et al., 2013; Deery, 1999; Laapotti et al., 2001) and situation awareness (Scott-Parker et al., 2020) which develop gradually from exposure to different traffic situations of varying complexity (Ehsani et al., 2017). However, additional studies providing more detailed information about the content of the accompanied driving and objective measures of driving skills are needed to assess if the extent and variety is sufficient to ensure improvements in driving skills, as exposure to complex traffic situations and manoeuvres have previously been shown to be more limited when the young driver is accompanied by a lay person compared to a professional driving instructor (Goodwin et al., 2014; Tronsmoen, 2011). In addition, studies show that self-assessed skills are more inaccurate in less skilled and high sensation-seeking drivers (Martinussen et al., 2017). Such information is relevant for the development of guidelines and regulations associated with accompanied driving in order to realize its safety potential.

In line with previous studies showing that a good collaboration between the young driver and the ACP is important for improving driving

### Table 4
Factors predicting self-assessed improvements in driving skills due to accompanied driving.

| Variable                        | Category                        | Est.  | SE    | P-value | OR    | 95% CI    |
|---------------------------------|---------------------------------|-------|-------|---------|-------|-----------|
| Intercept                       |                                 | -5.19 | 1.02  | <0.01   |       |           |
| Practice specific situations    | Yes                             | 0.57  | 0.25  | 0.02    | 1.77  | 1.09–2.87 |
| Included manoeuvres/ situations | Complex traffic situations      | 0.48  | 0.23  | 0.04    | 1.61  | 1.03–2.51 |
| Emotional climate               | Positive atmosphere             | 2.16  | 0.31  | <0.01   | 8.71  | 4.76–15.91|
|                                 | Hostile atmosphere              | -1.37 | 0.50  | <0.01   | 0.26  | 0.29–0.93 |
| Duration                        | ≤ 3 months                      | -0.78 | 0.30  | 0.01    | 0.46  | 0.25–0.83 |
|                                 | 4–6 months                      | -0.35 | 0.32  | 0.28    | 0.71  | 0.38–1.33 |
|                                 | 7 months or more                | -     | -     | -       | -     | -         |
| Number of observations          |                                 | 373   |       |         |       |           |
| Wald Chi-square (H₀: β = 0)    |                                 | 69.01 |       | <0.001  |       |           |
| Degrees of freedom             |                                 | 6     | AIC   |         | 421.14|           |
| Hosmer-Lemeshow, Model P-value |                                 | 0.53  | R-square | 0.25  |       |           |
skills (e.g. Nyberg et al., 2007; Trnsmoen, 2011), we find that self-assessed improvement in driving skills is positively associated with a positive atmosphere and negatively associated with a hostile atmosphere during the drive. In general, very little is known about verbal as well as non-verbal interaction between ACP and the young driver (Scott-Parker, 2017). Additional studies exploring this are therefore highly relevant, as such knowledge could serve to inform or educate future ACP to maximize the benefit of accompanied driving.

We did not find any significant effects of area of residence on licensing age, although living in the rural area Jutland almost became significant. If the mother never/rarely uses public transport the odds of licensing at 17 increases but additional studies are needed to assess the impact of car use in the family and the neighbourhood on licensing age.

4.1. Limitations

A few limitations should be mentioned in relation to the results of this study. The results are based on self-reported information collected via a survey. Such data is subject of several types of biases. First, it is possible that the results are influenced by self-selection bias so that people with a less positive attitude towards accompanied driving to some extent refrained from participation as participation is more likely on topics of interest (Groves et al., 2004; Lajunen and Summala, 2003; Roster et al., 2017). Second, for several aspects the participants are asked to provide their answer on a scale. However, the words included in the scale are somewhat ambiguous and may be interpreted differently by different participants (e.g. Wikman, 2005). In addition, the answers provided may be biased due to recall bias and consequently larger uncertainties for longer recall periods (e.g. Cherpetil et al., 2018; Stockwell et al., 2008). Thus, although self-reports have previously been recognized as a valuable proxy for objectively measured behaviour (e.g. Elliot and Baughan, 2004; Twisk et al., 2014) the indicated frequencies, durations, impacts etc. may be biased. Additional studies using objective measurements such as video recordings of the drives are relevant to achieve a more precise assessment of the investigated aspects. However, as the purpose of this study was to identify influential factors rather than exact amounts influence from such bias is less crucial.

5. Conclusion

In the context of a change in the Danish driving license scheme which introduces post-license accompanied driving at age 17 (L17), this study set out to increase knowledge about the use and users of accompanied driving. Our results indicate that youth licensing at 17 are less safety-oriented and may be more likely to engage in risk-taking behaviours, particularly speeding. Results further indicate that the well-known difference in crash-risk among young male and female drivers may be reinforced as results indicate different risk-profiles among female and male L17. Female participants seem more safety-oriented and motivated by a transport-related need for a driver’s license compared to male participants who are more confident about their driving skills and motivated by a wish to drive. In order to ensure the intended safety effect of introducing accompanied driving, targeted measures addressing speeding and other risk-taking behaviours are needed, particularly among young male driver candidates. In addition, our results indicate that allowing accompanied driving on a voluntary basis with no requirements regarding the amount or type of driving situations included does not provide sufficient additional driving experience to obtain the intended safety effect. However, additional studies are needed to establish a specific recommendation regarding this. Finally, our results confirm the importance of parental support to provide a supporting and facilitating environment which allows the young drivers to practice and develop their driving skills before solo driving.

CRediT authorship contribution statement

Mette Møller: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Writing – original draft, Writing - review & editing. Kira Hyldekar Jønstrup: Conceptualization, Methodology, Formal analysis, Writing - review & editing. Katrine Hjorth: Methodology, Formal analysis, Writing - review & editing. Divera A.M. Twisk: Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.aap.2021.106394.

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Muller et al. Accident Analysis and Prevention 162 (2021) 106394

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