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Attempting to systematize the effects of Graduated Driver Licensing (GDL) by selecting components

”Youth and Road Safety: Challenges and Solutions”

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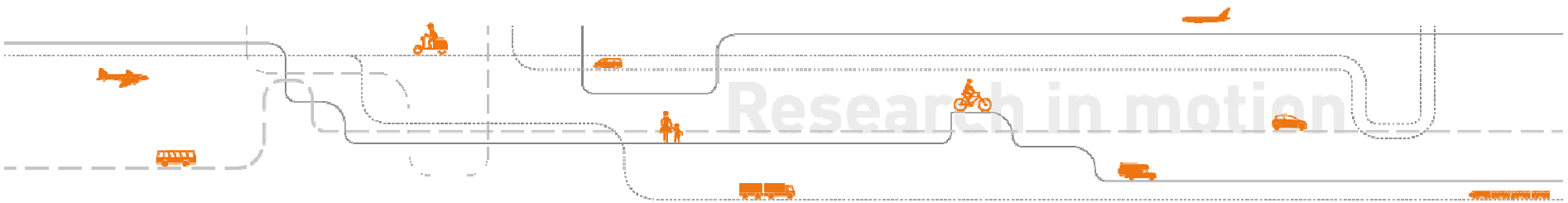
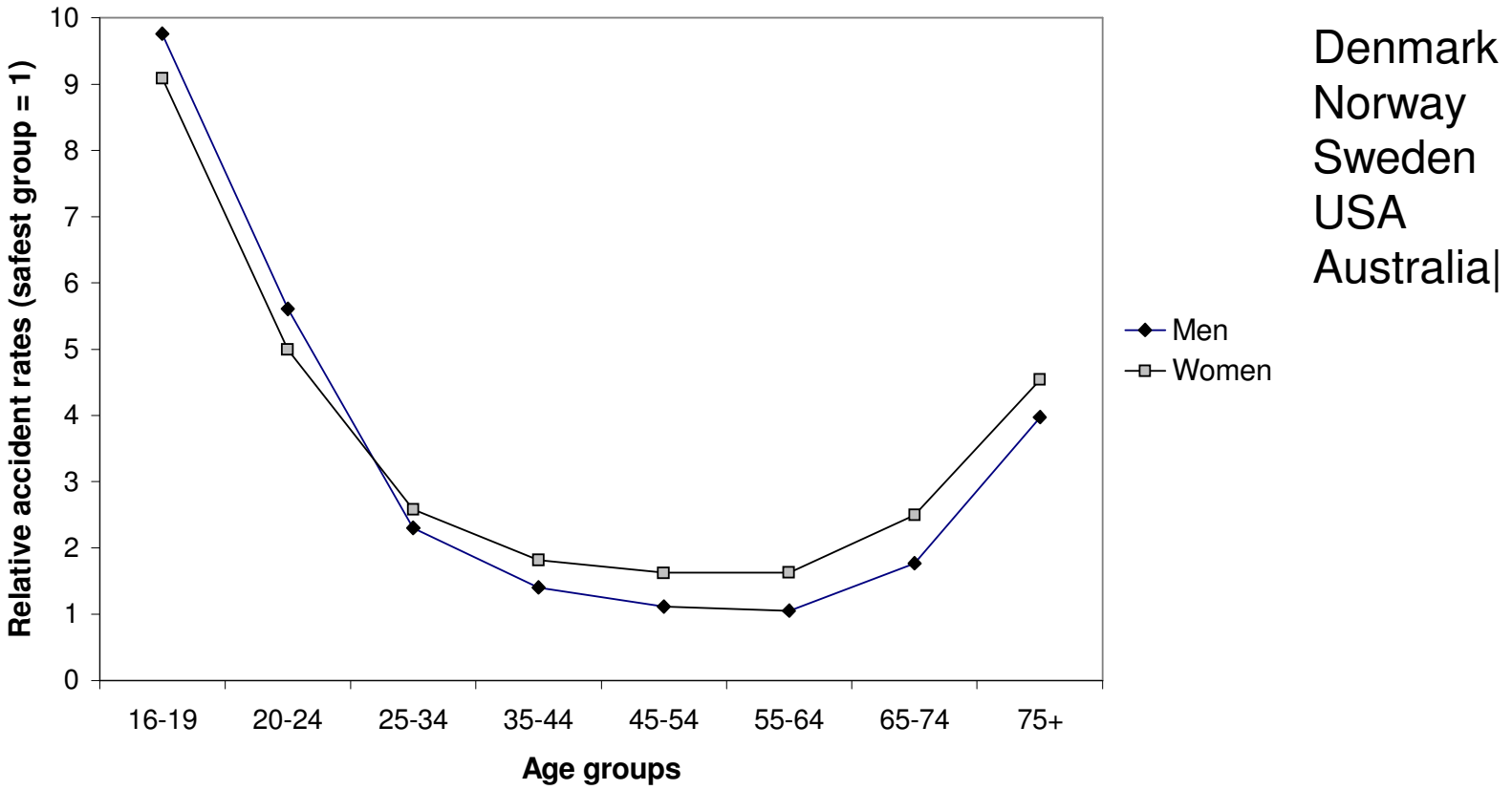


Known relative risks

State/condition	Relative risks
Drink driving – BAC + 0,15 % (sober = 1,00) (Glad 1985)	65
Drink driving – BAC 0,100 – 0,149 % (sober = 1,00) (Glad 1985)	25
Driver of MC (driver of personal vehicle = 1,00) (Elvik et al 1997)	13.2
Drink driving – BAC 0,050 – 0,099 % (sober = 1,00) (Glad 1985)	10
Male drivers aged 16-19 (vs male drivers 45-64 (Elvik et al, 2009)	9.8
Female drivers aged 16-19 (vs male drivers 45-64 (Elvik et al, 2009)	9.1
Drivers with sleep apnoea (Vaa 2003)	3.71
Mobile telephone use (Sagberg 1998)	2.20
Driving in 70 kmh compared to 50 kmh (Elvik et al 2004)	1.96
Immigrated, male drivers (Norway drivers = 1.00) (Nordbakke & Assum)	1.96
Driving in darkness compared to daylight (Elvik et al 1997)	1.5
Road surface covered with wet snow compared to dry road (-"-)	1.5
Driving in 60 kmh compared to 50 kmh (Elvik et al 2004)	1.44
Health impairments – average of 10 main groups EU Council directive	1.33
Driving on wet road compared to dry road kmh (Elvik et al 1997)	1.3

Relative risk of personal injury accident according to age and gender (Elvik et al. 2009)



Denmark
Norway
Sweden
USA
Australia|

Law of nature ?
Basically a learning curve…..
From risk of predators to risk of car accidents

"Traditional" driver training	*Decade*		*Decade*	*"New thinking" in driver training*
• Theoretical knowledge & (accidents)	• 1969 (1) • 1970s (5) • 1980s (2)	N=8		
• Formal driver training	• 1960s (2) • 1970s (5) • 1980s (6) • 1990s (3)	N=16		
• Amount: # of formal driver training hours:	• 1960s • --------- • 1990s	N <16		
• Defensive, anticipatory driver training	• 1963 (1) • 1970 (1) • 1980s (2) • 1990s (3)	N = 7		
• Driving tests (formal –theoretical)	• 1970s (2) • 1980s (5) • 1990s (3)	N=10	• 1980s (4) • 1990s ?	• Night-time restrictions • Passenger restrictions ?
• Skid training – personal cars	• 1980s (3) • 1990s (3)	N=6	• 1992 (1) • 2004 (1)	N=2 • Probationary driving licenses:
• Skid training – professional drivers	• 1983 (1) • 1996 (1)	N=2	• 1980s (2) • 1990s (5) • 2000s (16)	N=23 • Graduated Driver Licensing – "boom" after 2000….
• Driving in darkness	• 1988 (1) • 1992 (1)		• 2000 (1)	N = 1 • Increase of private, supervised driver training from 16 yoa

Driver education and training: The issue of *learning*

- **"Traditional" driver education: 1960s – 1990s**
  - *(Theoretical) knowledge*
  - *Formal driver training*
  - *Skill training ....*
- **"Innovative, new thinking" "GDL": 1980s – present**
  - *Night-time driving restrictions*
  - *Passenger restrictions*
  - *Penalty point systems*
  - *Reduction of BAC-limit (0.2 ‰: Sweden, Norway...)*
  - *Private, supervised driver training: Significance of the quantity*
  - *GDL: Learner stage, intermediate stage, driving solo*

- **Graduate Driver Licensing (GDL):**
- How to optimize GDL by selecting the best combination of components ?

- **In learning terms: The establishment of schemes – the process of automation**
- **The role of emotions:** $S^D \rightarrow R \rightarrow S^R$

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Formal driver training : Summary (N = 16)

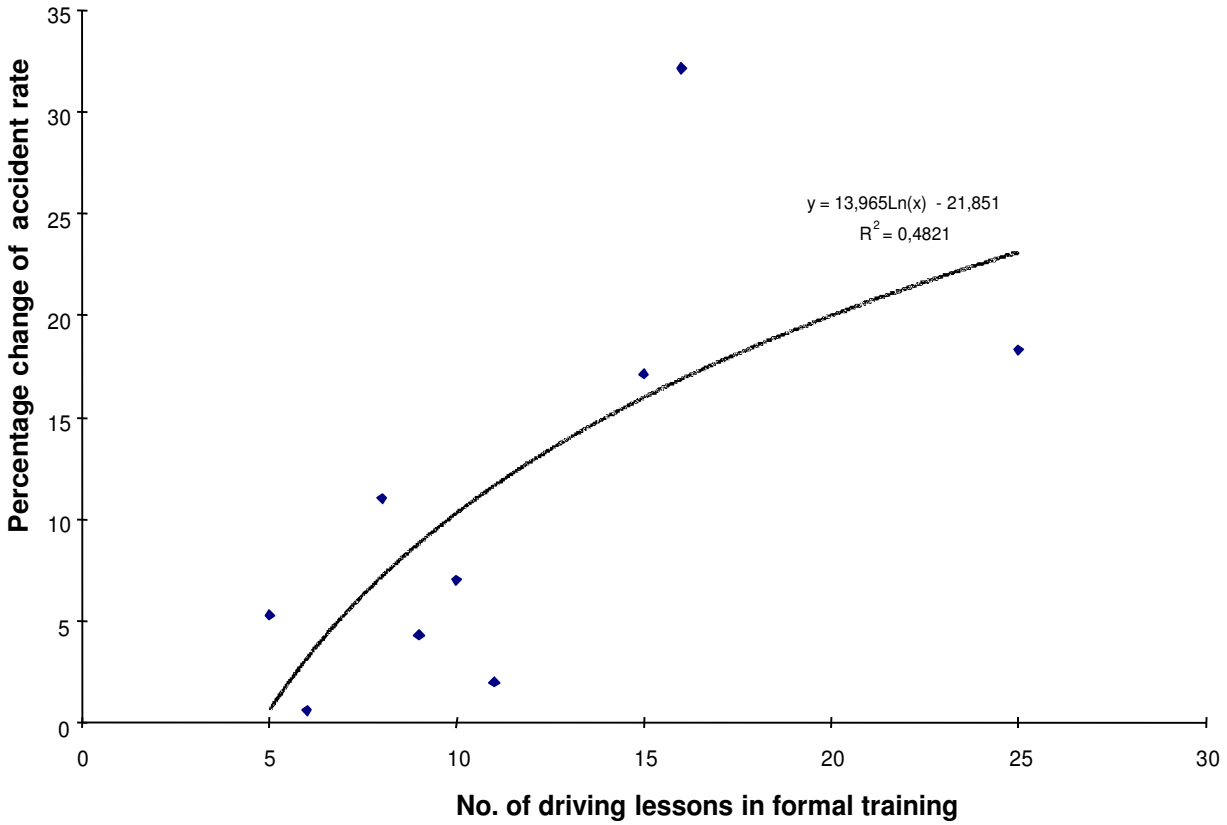
- Organized programs, private or public driving schools, professional teachers
-
- 16 studies : 1967 – 1996
- USA: 8
- England: 2
- Finland: 2
- Australia New Zealand Norway Sweden 1

- Summary – meta-analysis (Elvik et al, 2009) : Effects on accidents :

  - ***All studies:*** ***- 2%*** ***± 2***
  - ***All studies/pr km :*** ***- 4%*** ***± 2***
  - ***Experiments:*** ***0*** ***± 4***
  - ***Experiments/pr km :*** ***+11%*** ***± 4***

- (Theoretical) knowledge: No effect on accidents

Relationship between the number of driving lessons and the effect of formal training on the driver's accident rate.



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Handbook of Road Safety Measures (2009)

Effects of *skill training* for drivers on the number of accidents per driver.

Accident severity	Type of accident affected	Percentage change in the number of accidents: Best estimate	95% confidence interval
	Skid training		
Unspecified	Accidents in icy conditions, passenger cars	**+ 12**	(+7; +18)
Unspecified	Accidents in icy conditions, ambulance drivers	**+ 45**	(-35; +220)
Unspecified	Accidents in icy conditions, drivers of heavy vehicles	**+ 22**	(+9; +36)
	Night driving course for passenger cars		
Unspecified	Accidents in darkness	**+ 11**	(+4; +20)
	Defensive driving problem drivers		
Unspecified	All accident types	**- 8**	(- 4; - 12)

GDL-component(N = 20)	*month/jurisdic/year*
Minimum # of months in 1st phase ('learner stage')	0-12 (average: 6,0)
Maximum # of months in 1st phase ('learner stage')	0-48 (average: 6,8)
Minimum # of hours with supervised driving in 1st phase	0-60 (average: 22)
# of jurisdictions with mandatory # of hours supervised driving at night	35
# of jurisdictions without mandatory # of hours supervised driving at night	43
# of hours with prohibition against night-time driving 1st phase	0-10 (average: 1,3)
# of jurisdictions with abolition of night-time driving **if receiving supervision**	Yes: 3 No: 71
# of jurisdictions with passenger restrictions in 1st phase	Yes: 11 No: 67
Passenger restrictions abolished if passenger is family member	Yes: 2 No: 76
Abolition of passenger restrictions for family members if learner driver participate in formal driver training and is accompanied by instructor	Yes: 1 No: 77
Minimum age at the beginning of 1st learner stage	14-16 (average:15)
Formal driver training requirements in 1st learner phase:	
Mandatory	17 jurisdictions
Duration of learner phase scaled down if attending formal driver education	8 jurisdictions
No requirements:	35 jurisdictions
# of hours with prohibition of night-time driving intermediate phase	0-10 (average: 4)
# of jurisdictions abolishing night-time curfew **if driving to workplace**	Yes: 2 No: 74
# of jurisdictions with passenger restrictions in intermediate phase	Yes: 47 No: 31
# of jurisdictions where passenger restrictions are abolished in intermediate phase if learner driver is accompanied by qualified supervisor	Yes: 3 No: 74
# of jurisdictions where passenger restrictions are abolished in intermediate phase when passengers are close relatives	Yes: 36 No: 41
Minimum age when entering intermediate phase	14,5 – 17 (16,1=
# of jurisdictions with formal requirements regarding driver training In intermediate phase	Yes: 2 No: 54
# of jurisdictions with mandatory test at the of intermediate phase	Yes: 7 No: 50

Selecting 3 of 20 components => 1186 combinations

Evaluation of GDL-programs in North America using a meta-analytic approach (AAP - Vanlaar et al. 2009)

- GDL in 78 American and Canadian jurisdictions
- Objective: Assess the relative impact of GDL-components

- USA: Fatality Analysis Reporting System (FARS)
- Canada: Transport Canada's Traffic Accident Information Database (TRAID)

- **Reduction of relative fatality risk of 16 year old drivers: - 19,1 %**

- Effect of passenger restrictions on relative fatality risk: **- 88,5 % (11 of 67)**

- Relative fatality risk Canadian drivers19 yoa > USA: **+ 1229 % (12/47)**

- Relative fatality risk 19 yoa night-time restrictions abolished : **+ 5109 % (2/74)**

- **# of variables vs # of cases: Collapse of method ?**

- **More research: Systematizing published results (102 studies ….)**

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Evaluated GDL-components (n=13 of 20)

- Night-time restrictions
- Probationary driving license
- Driver training from 16 years of age

- Private, supervised driver training
- Formal driver training, driving schools, professional teachers

- Effect when driver training implies driver restrictions
- Effect of training linked to driving tests

- Effect of alcohol restrictions
- Maximum limit of traffic violations
- Logging of behaviour data (”black box”)
- Restrictions on the number of passengers
- Restrictions on motorway driving

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Effects on accidents of driving restrictions and GDL (Elvik et al. 2009)

Accident severity	Types of accidents affected	Percentage change in the number of accidents: Best estimate	95% confidence interval
	GDL (N = 23)		
Injury accidents	All accidents		
	Controlled for publication bias:	**- 6**	(-12; 0)
Fatal accidents	All accidents	**- 28**	(-50; +5)
Unspecified	Night time accidents	**- 31**	(-46; -12)
Unspecified	Single vehicle accidents	**- 21**	(-29; -13)
Unspecified	Accidents involving illegal BAC	**- 23**	(-56; +35)
	GDL for motor cyclists		
Injury accidents	All accidents	**- 25**	(-36; -12)
	Probationary driving licence		
Injury accidents	All accidents	**- 3**	(-4; -1)
	Night restrictions		
Injury accidents	All accidents	**- 7**	(-17; +5)
Injury accidents	Night time accidents	**- 36**	(-43; -28)

Effects on accidents of restrictions in GDL programmes (Elvik et al 2009)

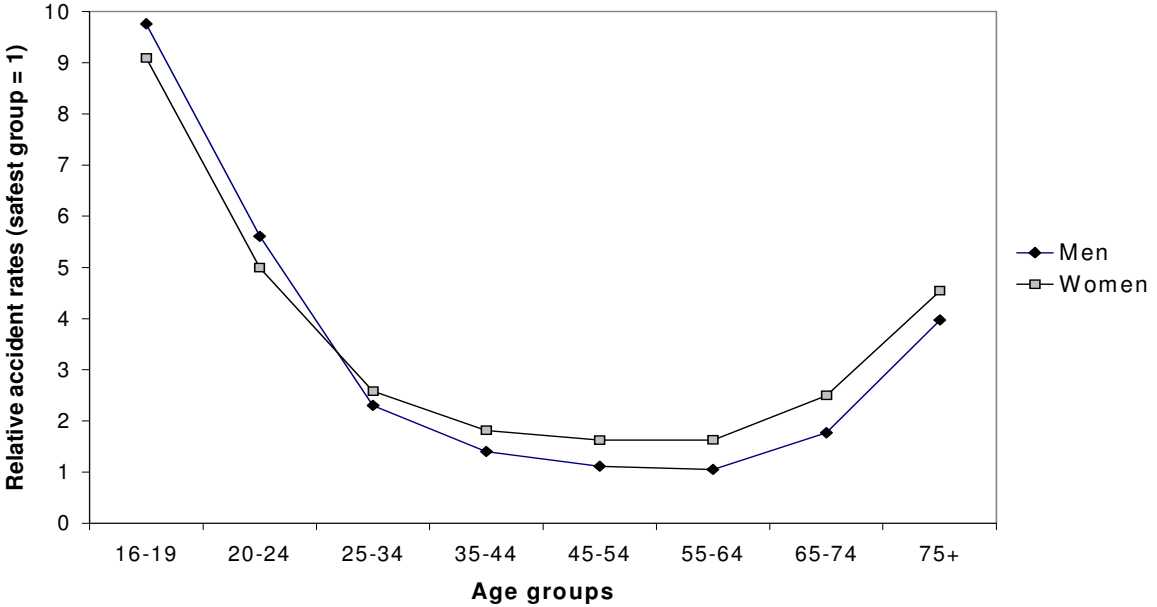
		Percentage change in the number of accidents	
Restrictions	**Types of accidents affected**	**Best estimate**	**95% confidence interval**
Night restrictions	All accidents	-18	(-23; -12)
No night restrictions	All accidents	-19	(-29; -9)
Night restrictions	Nighttime accidents	-46	(-54; -36)
No night restrictions	Nighttime accidents	-10	(-15; -5)
Lower BAC limit	All accidents	-17	(-24; -9)
No lower BAC limit	All accidents	-20	(-28; -12)
Violation restrictions	All accidents	-21	(-28; -14)
No violation restrictions	All accidents	- 15	(-19; -11)

Variable	V_1	V_2	V_3
Road parameter			
Lane width	X1		
Shoulder		X2	
Junction design			X3
Crosssection	……	……	…..
Roadside			
Road alignment			
Sight distance			
Guardrail			
Road surface			
……..			
Vehicle parameters			
……			

# of combinations

$3^{12} = 1.594.323$

”Building a library of schemes”



- *“Curriculum”: Enormous ! # of combinations .....*
- *No other activity/skill training/competence with such an curriculum*
- *7 years?/ 100.000 km ?*
- *40 years? / 500.000 km ?*

• *Defensive driving – experienced drivers:*	*- 21%*
• *Defensive driving – “problem drivers”:*	*- 8 %*
• *Economic driving (UK/TRL):*	*Tendency of accident reduction*
• *Maturation of the brain*	*25 yoa (men...)*

Private, supervised practice: Sweden vs Norway (Sagberg & Gregersen 2005)

Table 3. Crash involvement risk among drivers licensed at 18 years, for the first two years after licensing, before and after lowering of the age limits for driver training in Sweden and Norway. Crash involvements per million vehicle kilometres.

	Before	After	Percent change	Statistical significance
Sweden	0.98	0.81	- 17	p<0.05
Norway	1.31	1.28	- 2	ns

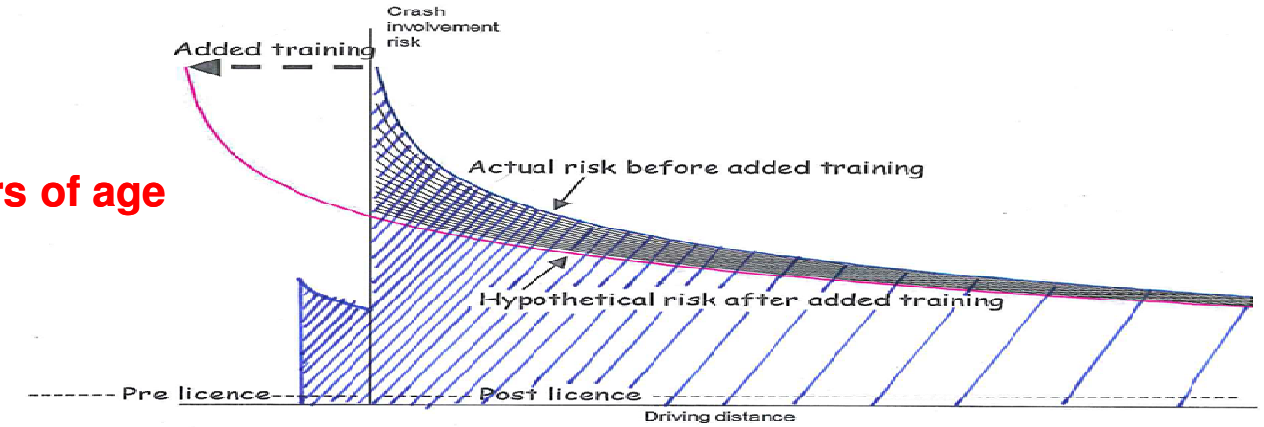
Private, supervised practice:

Sweden: 120 hours (1905 km:100% increase, total 3795 km)

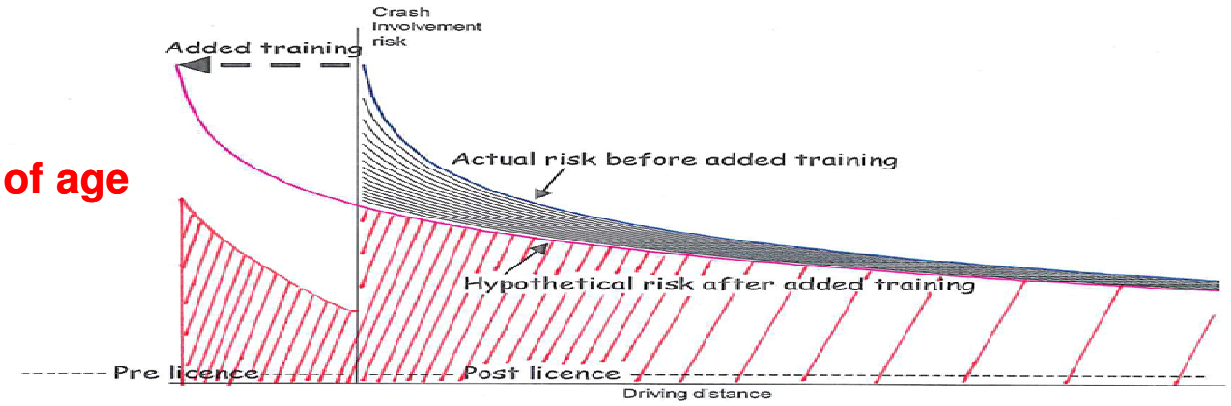
Norway: <<120 hours (1000 - 1500 km ?)

Gregersen et al. (2003): Consequences of supervised practice

Driver training from 17,5 years of age



Driver training from 16 years of age



Driving schools 1994–2000: **0 killed - 11 seriously injured**

Private, supervised practice 1994-2000: **22 killed - 115 seriously injured**

Summary – single components:

- Private, supervised driver training (n = 2?)
- Formal driver training => abolishing restrictions: + 27% (n = 1)
- Driving tests: No reduction in the number of accidents
- GDL: With or without night-time restriction ?
- GDL: With or without passenger restrictions ?
- GDL: With or without maximum number of driver violations ?
- ”Black-box”(n=1): No effect
- Passenger restrictions (n=1): Reduction of accidents
- Motorway restrictions: Inconclusive – increase/reduction of accidents

”The best composition of a GDL-program” – ”State of the art”:

- Private, supervised driver training ? Yes (”as much as possible” - $\geq$ 4000 km)
- Formal driver training ? No ?
- Night-time driving restrictions? Yes
- Passenger restrictions: Yes, indications
- Lowering BAC-limit ?: No tendency (0.2 ‰…..)
- Abolishing restrictions - formal driver training? No
- Maximum number of traffic violations?: Indications

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To forms of learning with opposite effects ?
Two hypotheses

Private, supervised practice: **More dangerous – objectively , more fatalities**
Parents: Limitations of where to drive/not to drive ?
Fear/emotions: ”Am I capable escaping any emergency?”
Is fear/insecurity passed on? ”Is fear contagious”?

Driving schools: **More safe – objectively, no fatality**
No limits of where to drive ?
Driving instructor can handle all emergencies ?
Communicating safety, security : ”Is mastering contagious” ?

Private, supervised practice:

Sweden:	120 hours
OECD (2008):	120 hours (Towards Zero: Ambitious Road Safety Targets)
Victoria (AUS):	120 hours (Interim report 2012)
Queensland (AUS):	120 hours (2013?)

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