Summative Evaluation of Accompanied Driving from Age 17

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Summative Evaluation of Accompanied Driving from Age 17

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Abstract

Summative Evaluation of "Accompanied Driving from Age 17"

To determine whether the model "Accompanied driving from age 17" (AD17) contributes to improvement of young drivers' road safety, two large random samples of novice drivers drawn from the Central Register of Driving Licences (ZFER) held at the Federal Motor Transport Authority (KBA) were compared in terms of the rates of accident involvement and traffic offences at the start of their solo driving career. The samples comprised former participants in the AD17 model and novice drivers of the same age who had obtained a driving licence in the conventional manner immediately after their 18th birthday. Both analysis groups were contacted by post and asked to complete an online questionnaire. In response, 19,000 drivers reported on their first year of solo driving and on the occurrence of any accidents or traffic offences during this period. The analyses were repeated with two "silent" analysis groups comprising a total of 75,000 drivers, for whom any records of traffic offences were retrieved from the Central Register of Traffic Offenders (VZR), with a distinction being made between offences in connection with an accident and other offences.

The AD17 model was introduced in all 16 German federal states between April 2004 and January 2008. By the end of 2009, almost one million novice drivers had participated in the model, and almost three-quarters of the target group – so-called "early beginners" who wished to commence solo driving immediately after reaching the age of 18 years – opted for the AD17 model. The phase of introduction of the model was associated with a temporary increase of around five per cent in the demand for driving licences from persons under 19 years of age.

During the first year of solo driving, the rate of accident involvement for AD17 participants was 19 per cent lower and the rate of traffic offences 18 per cent lower than for drivers of the same age who had obtained their driving licence in the conventional manner. After adjustment for confounds (e.g. gender and vehicle availability), a reduction in accidents by 17 per cent and in traffic offences by 15 per cent remained as an effect attributable to the model. A comparison on the basis of the distances driven indicated 22 per cent fewer accidents and 20 per cent fewer traffic offences. The results are statistically significant and apply to both male and female drivers. The findings were confirmed in the replication study based on VZR data, with one exception: For female AD17 drivers, and here only for VZR-recorded offences excluding accidents, no significant reduction was found. On the other hand, the rate for female drivers is already lower than that of their male counterparts by three-quarters.

Approximately 1,700 injury accidents were prevented by implementation of the model in 2009.

Content

Terminology

Observation period	Period during which all accidents and traffic offences are counted and to which all requested questionnaire data refer
Evaluation criterion	Accidents as the primary evaluation criterion: Specified in questionnaires (“self-reported accidents”) or retrieved from VZR data records (“VZR accidents”); Traffic offences as the secondary evaluation criterion: Specified in questionnaires (“self-reported offences”) or retrieved from VZR data records (“VZR offences”)
Early beginners	Survey population for this evaluation: Persons who obtain their driving licence at the earliest possible time; here: Before the end of the first quarter after their 18th birthday
Driving licence model	AD17 or conventional licence acquisition
Group E	Experimental group (at least 3 months of participation in the AD17 model) with driving licence of category B/BE
Group K	Control group (drivers of the same age not participating in AD17) with driving licence of category B/BE
Groups Ek, Kk	Contacted groups, i.e. survey respondents
Groups Es, Ks	“Silent groups“, i.e. not contacted as part of the survey, but with VZR data records retrieved
Groups Es1, Ks1	Silent groups recruited from 10 federal states early in 2007
Groups Es2, Ks2	Silent groups recruited from 11 federal states late in 2007
Group segments a to d	Further differentiation of groups Ek and Kk according to the time of recruitment (early, late) and completion of the initial survey (early, late)
Extrinscally motivated	Motivation to participate in the survey only after reminder and provision of a considerable incentive

Intrinsically motivated	Spontaneous motivation to participate in the survey without reminder and provision of a considerable incentive
Pre-test phase	Period before the commencement of solo driving; for AD17 participants this includes the period of accompanied driving
Post-test phase	Period after the start of solo driving
Person-years of observation	Product of the number of persons in the sample and the mean period of observation in years (example: 10 persons observed over a period of 1.25 years equals 12.5 person-years of observation)
Recruitment conditions	Issuing of a (full) driving licence for category B/BE at an age between 18.0 and 18.25 years; for AD17 participants, furthermore a minimum of 3 months accompanied driving
Recruitment period	Period during which all new entries in the ZFER were compared against the recruitment conditions
Self-selection effects	Personal characteristics which determine to a significant extent whether a person enrols in a voluntary measure; here relating to: a) AD17 participation, b) Survey participation
VZR accidents	Traffic offences entered in VZR data records in connection with an accident; the offence type suggests a joint responsibility for the accident
VZR offences	Traffic offences entered in VZR data records (including those connected with accidents)

Abbreviations

AD17	“Accompanied Driving from Age 17”
BASt	Federal Highway Research Institute
FeV	Driving Licence Regulations
IfeS	Institute for Empirical Sociology, Nürnberg
KBA	Federal Motor Transport Authority
VZR	Central Register of Traffic Offenders at the KBA (register of traffic offences and penalty points)
ZFER	Central Register of Driving Licences at the KBA

1 The problem

1.1 Background

In response to the great interest shown in accompanied driving from the age of 17 ("AD17") and initial positive experience gained under state-level regulations, a national legal basis for pilot implementations in the federal states was enacted in August 2005 (§ 6e StVG and §§ 48a and b FeV). With Baden-Wuerttemberg joining the pilot scheme as the last state on 1st January 2008, all the federal states in Germany have thus been involved since that date.

Evaluations of accompanied driving schemes in other countries suggest that the practical experience gained by the novice driver during the phase of accompanied driving translates into significantly reduced accident involvement in subsequent solo driving from the age of 18 years (Bundesanstalt für Straßenwesen 2003). It is not known, however, whether this positive experience also applies to the German driving context. This point relates not only to the potential impact of AD17 on road safety, but prior to this also to the question of actually reaching the target group, as the model is implemented as a voluntary measure. Positive effects on road safety can only be expected to the extent that the AD17 model gains broad acceptance and a sufficient number of novice drivers are able to benefit from the favourable learning processes of accompanied driving. This means that, in addition to the "summative evaluation" assessing the impacts of the model, a "formative evaluation" investigating its practical acceptance and implementation is also required.

As part of the overall evaluation of the AD17 model, the Federal Motor Transport Authority (KBA) took responsibility for determination and analysis of its effectiveness ("Outcome evaluation"; FE 82.316).[1] The formative evaluation was entrusted to the Institute for Empirical Sociology (IfeS) in Nürnberg ("Process evaluation"; FE 82.298).

1.2 Evaluation study on accompanied driving in Sweden

A reform implemented in 1993 reduced the minimum age for the commencement of accompanied driving practice in Sweden from 17.5 to 16 years. The minimum age for solo driving remained unchanged at 18 years (GREGERSEN, 1997, and GREGERSEN et al., 2000). In contrast to the present German model, the Swedish model did not require learners to pass a driving test prior to the commencement of accompanied driving. Those who did not wish to engage in earlier driving practice were still able to obtain a driving licence in the conventional manner with accompanied driving practice permitted from 17.5 years of age. It was (and is still today) a condition that the early driving practice be accompanied by a person at least 24 years of age and in continuous possession of a driving licence for at least five years.

In his evaluation study, GREGERSEN (1997) reports a reduction in accident involvement by 41% per 1,000 drivers and year (there Tab. 20) or by 43% per ten million kilometres driven (there Tab. 21) in the first year of solo driving compared to the group which underwent conventional training. These official figures from the national Swedish police statistics on accidents involving personal injury were supplemented with questionnaire responses from representative samples of approximately 1,000 persons each. These data revealed a reduction in accident involvement by only 32% (there Tab. 25).

GREGERSEN also proposed a further comparison, namely between drivers with early accompanied driving practice and those who commenced their practice regularly at 17.5 years of age before the lowering of the minimum age. In these comparisons, the reduction in accident rates was on average lower by a few percentage points.

In a later publication, GREGERSEN et al. (2000) repeated the analyses for an extended observation period of two years. The results indicated an even more pronounced effect of accompanied driving, namely reductions in the accident rate by 45 to 48%. In addition, proof of the statistical significance of the effects was furnished (there Tab. 3). Without explicitly mentioning the methodological problem of internal differentiation[2], the authors also demonstrate that the effects were not attributable to a slight gender difference regarding the uptake of the model of earlier driving practice (there Tab. 5).

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1 The authors would like to thank Ms. Christiane Bremer at the KBA for her critical revision of the manuscript and the many valuable suggestions for improvement.

2 Persons who take up the new offer of earlier driving practice differ systematically from those who choose the conventional model (for further discussion of this methodological problem, see "Hypothetical effect 2" in Section 1.3).

To obtain figures for the isolated effect of accompanied driving on accident risk reduction, GREGERSEN et al. (2000) attempt to correct the distorting contributions of three confounds, namely a slight difference in educational attainment, a slight age difference at the start of solo driving and a long-term downward trend in accident figures. The correction considerably reduced the reported effects, in one extreme case by half; the observed reduction, however, remains impressive, with 40 to 42% fewer accidents compared to previous figures and with 24 to 27% fewer accidents compared to the reference group of conventionally trained novice drivers (p. 33, Table 8).

A remarkable finding of GREGERSEN et al. (2000, p. 31) is presented in Fig. 3, which shows the monthly number of accidents per 1,000 drivers over the first 24 months of solo driving. The curve for drivers with earlier driving practice is not only impressively lower (on average 60% below the curve for drivers before the lowering of the minimum age limit), but also approaches zero after 24 months; at the same time, the relative difference between the two groups becomes ever greater. However, the methodology used does not permit the prediction of an unexpectedly great, sustained and even increasing effect of accompanied driving beyond reasonable doubt.

1.3 Questions addressed by the summative evaluation

A summative evaluation centres on the "outcome" of the measure to be evaluated; in the present context, this comprised road safety and compliance with traffic rules. The focus is the effectiveness of the model on accident involvement and traffic offences for young novice drivers in their early solo driving career. The evaluation compares the traffic accident and traffic offence involvement of novice drivers who participated in the AD17 model with that of novice drivers of the same age who obtained a driving licence in the conventional manner.

A direct comparison, however, would be inappropriate, as the experimental methodology criterion of random allocation of participants to treatment groups ("randomisation") was not fulfilled. The members of the two groups, (participants in the AD17 model and conventionally trained drivers) opted for one of the two licence acquisition models on the basis of private considerations and therefore allocated themselves to one of the two study groups ("self-selection"). It can thus be expected that the groups differ systematically with regard to certain variables, possibly including variables closely associated with their individual accident risk and driving behaviour.[3] It is thus necessary to identify and measure such extraneous factors and to control for them adequately in later comparisons.

Three effects could conceivably follow the implementation of the AD17 model and must thus be taken into account in an evaluation. For the sake of maximum clarity, they are described separately in the following; in practice, however, individual effects may overlap to a certain extent:

Hypothetical effect 1: Model expands the at-risk population

The introduction of new options in an existing offering generally stimulates increased demand, for example because new target groups are addressed. Persons who would otherwise have obtained a driving licence later, or possibly not at all, may be especially receptive to the new AD17 model. Consequently, the number of 18-year-old drivers increases, and with it the number of traffic accidents involving this age group (Fig. 1, right-hand block compared to left-hand block).

Hypothetical effect 2: Model leads to internal differentiation into higher- and lower-risk drivers[4]

The introduction of a new option, and thus of greater choice, may lead to differentiation within the target group. Persons with characteristics which correlate with a lower accident risk, e.g female gender and higher educational attainment, may gravitate towards the group of AD17 drivers (analysis group E). Consequently, those with a higher accident risk form the bulk of the group of "conventional novice drivers", i.e. those who obtain a driving licence in the conventional manner

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3 It is conceivable, for example, that especially car enthusiasts are attracted by the AD17 model. This characteristic could in turn be associated with a high annual mileage and consequently a higher risk of accident involvement and traffic offences. This association means that a direct comparison without consideration of the extraneous variable "car enthusiast" could give the impression that participation in the AD17 model leads to an increased risk.

4 In accordance with actuarial terminology

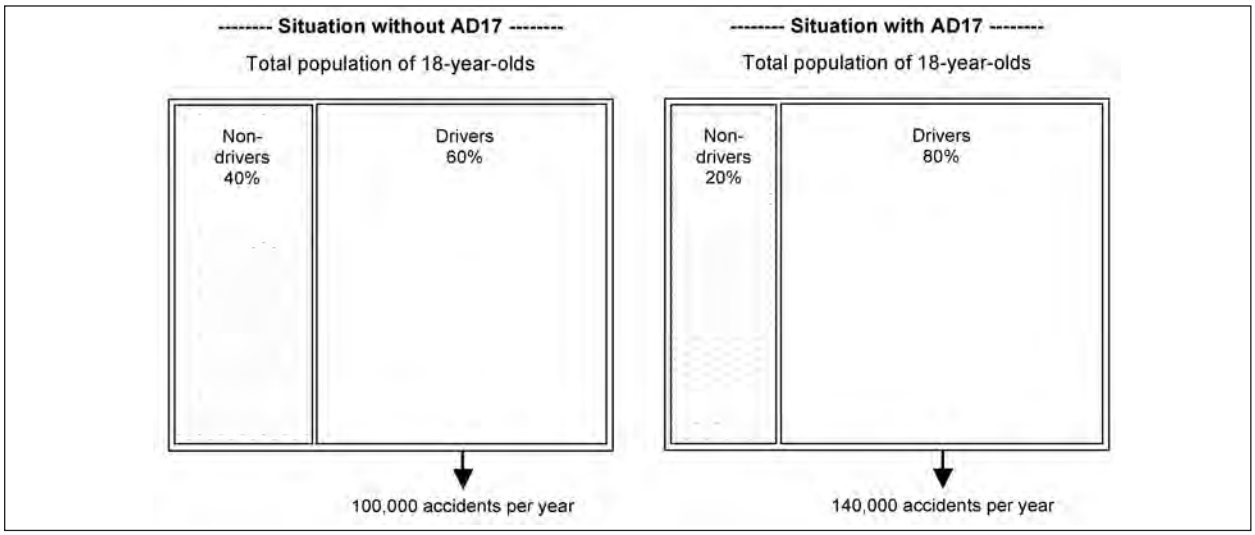

Fig. 1: Model expands the at-risk population (figures for illustration only)

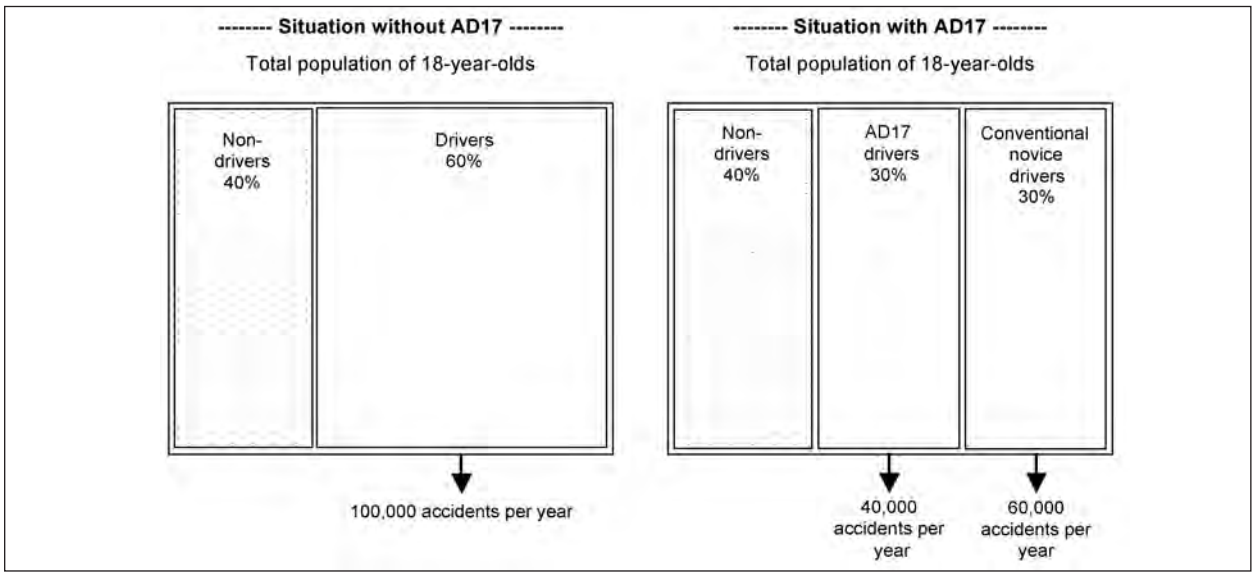

Fig. 2: Model leads to internal differentiation between high and low risks (figures for illustration only)

(analysis group K). The total number of accidents across both groups is unaffected by the internal differentiation (Fig. 2), meaning that there is no discernable gain for road safety.

In this scenario, the number of accidents in the AD17 group is 10,000 lower than to be expected after division into two equal groups; that for the conventional novice drivers is correspondingly 10,000 higher. The total number of accidents across both groups remains unchanged at 100,000.

Hypothetical effect 3: Model itself reduces risk

Certain components of the AD17 model exert (causal) positive influences on the participating drivers and thus lower their accident risk (Fig. 3). The accident risk of the conventional novice drivers remains unchanged and corresponds to their proportion of the overall pool of drivers (in the chosen example: 50,000 accidents).

Superimposed effects

In practice, all three effects may be found superimposed. One of the challenges for an evaluation is thus to differentiate the aforementioned effects. Effect 3, and with it the question as to whether accompanied driving holds a risk-reduction potential is of crucial importance. The finding of a lower per capita risk for AD17 drivers compared to conventional novice drivers alone, however, does not allow differentiation between Effect 2 or Effect 3.

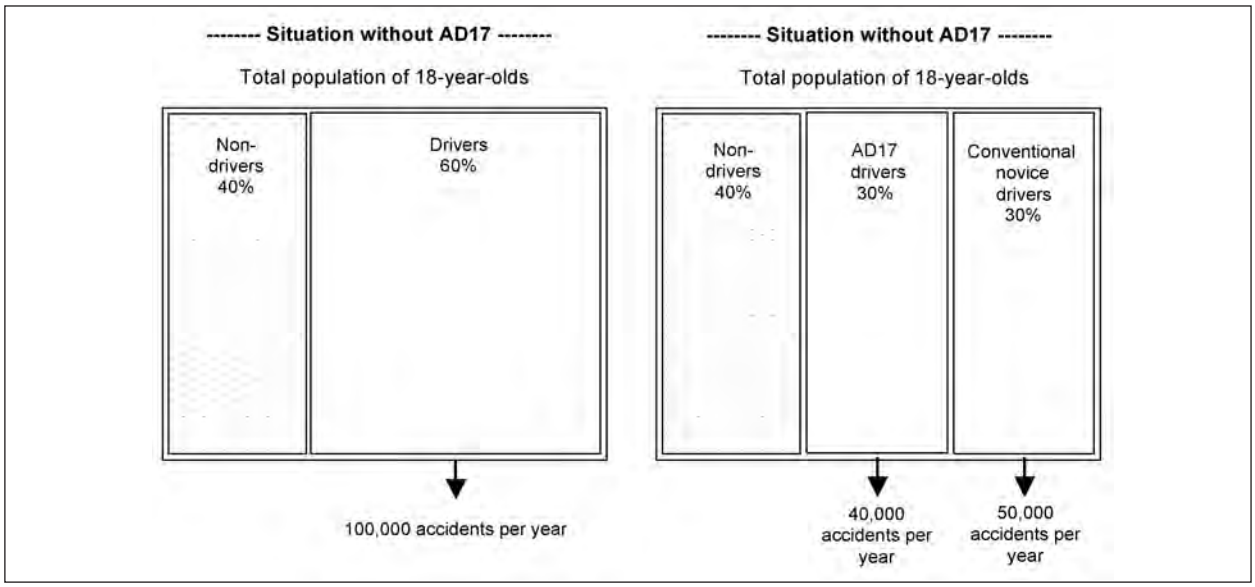

Fig. 3: Model (causally) reduces risk (figures for illustration only)

2 Method

2.1 Research design

2.1.1 Study structure

The statistical method of a control group was chosen to test the effectiveness of the AD17 model; as the assignment of persons to the analysis groups is not "randomised"[5] (see previous section), additional "confounding variables"[6] must be taken into account.

Two analysis groups distinguished by their chosen "Driving licence model" are to be compared: The "Experimental group" E comprises persons who participated in the pilot scheme of the AD17 model, the "Control group" K those who obtained a driving licence in the conventional manner.

Whereas all participants in the AD17 model are of interest for a formative or process evaluation, it seems inappropriate for an outcome evaluation focused on investigating the effectiveness of the model to include those persons who only participated in the AD17 model for a few weeks before their 18th birthday. Such a short phase of accompanied driving does not reflect the intention of the AD17 model and is unlikely to achieve essential effects. The experimental group E for this outcome evaluation thus considers only those persons who participated in the AD17 model for at least three months.

Group	AD17 participation?	Survey?	VZR records?
Contacted experimental group (Ek)	yes	yes	yes
Contacted control group (Kk)	no	yes	yes
Silent experimental group (Es)	yes	no	yes
Silent control group (Ks)	no	no	yes

Tab. 1: Overview of analysis plan

A subset of each group was contacted by post and asked to complete a questionnaire (on a voluntary basis) collecting information on socio-demographic background, driving practice, driving behaviour and any accidents or traffic offences. These subgroups are referred to in the following as the "contacted groups" Ek and Kk. The remaining groups (see Tab. 1) were not contacted and are thus referred to as the "silent groups" Es and Ks. At the end of the observation phase, the Central Register of Traffic Offenders (VZR) was consulted to retrieve the data records relating to potential traffic offences committed by the members of all groups.

5 A method used in experimental design where the objects are assigned at random to different treatment groups

6 Variables which lead to a spurious correlation between two other variables if they are not taken into account (example: In a survey among school pupils, higher pocket money appears to be associated with better long-jumping performance. This correlation, however, only arises because the age of the respondents, as a confound, is not taken into account).

The contacted samples serve primarily to test the statistical "null hypothesis", namely that participation or non-participation in the AD17 model has no impact on the accident risk for 18-year-old drivers during the first year of solo driving, against the "alternative hypothesis" that participation in the AD17 models lowers the accident rate. To this end, it is necessary to gain as complete an overview as possible of the accident involvement of the test persons, including accidents which were not recorded by the police, e.g. bagatelle and single-vehicle accidents. The method of choice is thus a survey which covers additionally (penalised) traffic offences without entries in the VZR records. The "hard facts" from the VZR complement the picture derived from the survey responses.

The silent analysis groups serve firstly to control for possible "self-selection" and "observation effects"[7]. The comparison between the silent and contacted groups could reveal that the contacted groups, which comprise solely persons who are particularly receptive for the aims of the model, are more moderate and commit fewer traffic offences; this circumstance would be very important for interpretation of the results. Furthermore, these large, additional analysis groups permit finer analysis of the extent of risk reduction and its development over time. The final purpose of the silent analysis groups is to enable replication of the previous results with large, independent samples.

The sample sizes required for the silent analysis groups can be achieved at favourable cost, as they can be retrieved directly from the registers maintained at the KBA and do not have to be contacted by post. The questions addressed in connection with these analysis groups refer solely to legal proving and accident data from the VZR.

All the aforementioned groups were selected as true random samples from the Central Register of Driving Licences (ZFER) at the KBA. The statistical population for the sampling comprised all those persons from federal states participating in the model on the reference date, provided they received a driving licence for vehicle class B or BE during a certain period ("recruitment period", see Section 2.3.1), namely during the first quarter after their 18th birthday (so-called "early beginners"). As already mentioned, the participants in experimental group E had completed at least three months of accompanied driving.

The sampling ensured furthermore that the persons belonging to groups which were to be compared directly, namely Ek and Kk or Es and Ks, began solo (i.e. unaccompanied) driving during the same period of the year 2007, and that their places of residence (at least at the time of issuing of the full driving licence) were spread proportionately over the participating federal states (sample matching by federal state).

The driving behaviour of all groups was analysed separately during two observation periods:

a) A "pre-test phase" before the start of solo driving covered the period between a person's 17th and 18th birthdays.[8] For the experimental group E, this phase included the period of accompanied driving, which began at individually different times after their 17th birthday.

b) A "post-test phase" covered the period from the start of solo driving (after a person's 18th birthday) until at least the end of the first year of solo driving.

The data from the post-test phase serve to verify the effectiveness of the model (comparison of accidents and traffic offences for AD17 participants and conventionally trained novice drivers). The data from the pre-test phase are necessary to clarify the rates of accidents and offences during the phase of accompanied driving. The question addressed in this context is whether the requirement of accompaniment achieves protective effects of a comparable size to those demonstrated in other countries, e.g. in Sweden (GREGERSEN et al., 2000).

The targeted period of observation in the post-test phase was at least 12 months for the contacted analysis groups Ek and Kk and at least 24 months for the silent analysis groups Es and Ks. The actual observation periods achieved are shown in Section 3.3.

The "critical incidents", namely traffic accidents and officially recorded traffic offences (whether self-

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7 See also the so-called Hawthorne effect known from social psychology research: Persons who are aware of particular observation or even merely attention within the framework of a study display positive changes of behaviour almost independently of the treatment intervention targeted at them.

8 Even though the K group is not legally entitled to drive a car during this period, other accidents and traffic offences (and even car-related incidents) must nevertheless be expected.

reported or retrieved from VZR records), supplied information for the so-called dependent variable of the analysis design.

2.1.2 Questionnaires and VZR records as data sources

Questionnaires

The individual driving licence number was used to obtain an address from the responsible licensing authorities for each of the persons selected from the ZFER for recruitment of the analysis groups Ek and Kk. They were subsequently contacted by post and asked to participate in the survey. The selected novice drivers were able to signal their interest via the Internet and could either complete a questionnaire online or else ask to be posted a paper version.

Alongside the initial survey, scheduled as early as possible in the post-test phase, a final survey was planned after the first year of solo driving. An intermediate survey was included to reduce the time intervals between questionnaires and thus to minimise the risk that respondents could have forgotten relevant incidents which happened during the observation period. The aim was to schedule questionnaires in such a way as to avoid gaps of more than six months wherever possible.[9] The phases to be covered by questionnaires were the periods between the start of solo driving and the initial survey, between the initial and intermediate surveys and between the intermediate and final surveys. The questionnaire schedule actually implemented is presented in Section 2.3.2.

Due to the high costs of postage, all further replies after the first contact and initial survey were to be based solely on online questionnaires. The review of survey results on Internet use during the planning phase of the project gave promising indications (KORUPP, KÜNEMUND & SCHUPP, 2006): The age group of 18-year-olds described there as the "Internet generation" already reported an 83% rate of Internet use in 2005, with a steeply increasing tendency. A rate of 90% thus seemed realistic for 2008, especially with regard to the holders of a driving licence; this justified the decision to dispense with postal questionnaires in the further survey phases.

The aforementioned study also shows, however, that online surveys entail significantly fewer respondents with lower educational attainment, fewer residents of certain regions of Eastern Germany and fewer female respondents. The methodology of the present study must thus take these factors into account as potentially distorting influences.

Regarding the technical realisation of the online questionnaires, reference is made to the descriptions of the Institute for Empirical Sociology in Nürnberg (IfeS), which managed the survey (FUNK & GRÜNINGER, 2010, Chapter 2.3).

VZR records

Data records were retrieved from the Central Register of Traffic Offenders (VZR) to determine the numbers of officially recorded traffic offences with and without indication of an accident. The first round of VZR queries served to reveal possibly existing VZR records from the pre-test phase. A subsequent second round of queries covered the period of the post-test phase.

2.1.3 Variables

The variables to be determined were grouped and designated according to their role in the analysis plan:

- "Evaluation criteria" (dependent variable), namely traffic accidents and traffic offences,
- "Driving licence model" (independent variable): A variable with two possible values indicating membership of the group E or K (i.e. AD17 participants or persons obtaining a driving licence in the conventional manner),
- "Control variables" (confounding variables): Here, among others, gender and educational attainment, whose influence must be taken into account in the calculated comparisons between the driving licence models,
- "Behaviour determinants": Aspects of driving behaviour which could influence the evaluation

[9] CHAPMAN and UNDERWOOD (2000) studied the recollection of near-accidents and concluded that they were quickly forgotten, especially in the case of less serious incidents and incidents not associated with a blemish of fault. (The present study, therefore, does not gather data on near-accidents.)

criteria to a decisive extent, e.g. vehicle availability, vehicle use or driving style,

- "Response medium": A variable with two possible values indicating the medium chosen by the survey respondent, namely online questionnaire via the Internet or paper questionnaire sent by post.

Evaluation criteria

The outcome evaluation is geared primarily to the criterion of accident reduction. The primary indicator is thus the accident rate: For the silent analysis groups Es and Ks, the accident rate is determined from the corresponding entries in the VZR records ("VZR accidents"), for the contacted analysis groups Ek and Kk additionally from the accidents reported by way of the questionnaires ("self-reported accidents").

As the traffic regulations serve also to promote road safety, as well as the smooth functioning of traffic and a positive climate on the roads, the rate of traffic offences committed is also used for evaluation as a secondary criterion; this can be viewed as a measure of "legal proving". Where necessary, finally, the primary and secondary indicators can be combined into an overall indicator "accidents and traffic offences, for example to boost the statistical significance, when analysing small subsets of the sample or to permit generalised statements.

The evaluation criteria or dependent variables are thus:

- the indicator "accidents",
- the indicator "traffic offences" and where appropriate
- the overall indicator "accidents and traffic offences".

The question which follows from definition of the evaluation criteria concerns the appropriate basis for calculation of the rates of accidents and traffic offences: Should the rates be referred to a certain period and population – here per 1,000 drivers and year – or to the distance driven – here per million kilometres? In other words: Should the evaluations be period-based or kilometre-based?

SCHADE and HEINZMANN (2008, p. 17) discuss the conditions under which a period-based criterion (per 1,000 drivers and year) is more appropriate than a distance-based criterion (per million kilometres). In administrative contexts, especially where the private driving licence holder is the subject of decisions, the authors argue against the use of a kilometre-based assessment. For example, it is for a good reason that the law grants no "mileage bonus" with regard to traffic offences and accidents (cf. also HOLTE, 2006).

On the other hand, one of the objectives of the AD17 model is to promote the development of driving competence. As such competence can be operationalised as the frequency of errors relative to distance driven, the frequency of accidents and traffic offences per million kilometres should therefore be considered as a second criterion alongside the period-based assessment.

Variables measured via questionnaires

Alongside the expected influence of AD17 participation which is to be investigated in the present study, there are many other factors which influence the rates of accidents and traffic offences to different extents and in different directions. The gender- and age-specific effects demonstrated in numerous studies play an important role, as does the extent of the driving practice before and during the observation period; the latter is operationalised as the number of kilometres driven. Different personalities, attitudes to driving and parental role models promote the development of different types of driver with distinct propensities to observe rules or take risks. The effects of an unequal distribution of such factors between the two samples Ek and Kk could overlay the effect of the AD17 model and hinder its identification.

Such personal and attitude-related variables must be acquired directly from the survey participants. Initial, intermediate and final questionnaires served this purpose.

The variables considered by the analysis are shown in Tab. 2 together with the times at which they were acquired. Alongside socio-demographic data, supplemented by the educational attainment of the respondent's parents, the questionnaires addressed

- possible road practice before obtaining a driving licence,
- the phase of accompanied driving,

- current driving practice during the phase of solo driving,
- general attitudes towards driving and
- "background variables" which could play a role for more profound interpretation of the results.

The "background variables" aimed to assess general personality traits of the respondents. The psychology of individual differences distinguishes five fundamental dimensions which vary from person to person and are reflected in individual behaviour tendencies in many situations, namely extraversion, agreeableness, conscientiousness, neuroticism and openness to experience (LANG & LÜDTKE, 2005). The framework of an extensive survey only reasonably permits a brief questionnaire to acquire these variables with a minimum time outlay. After consultation with the IfeS, which performed the process evaluation, the present study used the 10-item "BFI scale" recommended by RAMMSTEDT (2007) and by RAMMSTEDT and JOHN (2007), plus an additional item. Discussions occasionally address the insufficient consideration of risk-taking propensity as a trait (ANDRESEN, 1995). Given the obvious association with driving behaviour, this factor was also included in the evaluation: It is measured by two questionnaire items which are structured in the same way as BFI scales (regarding the items and their psychometric properties, see FUNK & GRÜNINGER, 2010, Tab. 7-9)

Concerning the evaluation criterion, i.e. the dependent variable in the analysis plan, information was requested on driving behaviour relevant to the evaluation, namely all forms of accident involvement, irrespective of the degree of fault[10] and all kinds of penalised traffic offences. For the evaluation of this self-reported behaviour, "significance thresholds" were defined to establish a common set of criteria for the exclusion of bagatelle incidents for all groups. The significance threshold for accidents was damage of "significant value" (defined as damage worth €1,200 or more, in line with current legal practice according to § 315c of the German Criminal Code, StGB) or injury to persons. It was here irrelevant whether the damage or the injury was incurred by the survey participant or a third party. An additional indicator for exceeding of the agreed relevance threshold was the recording of an accident by the police, as is recommended and practised in case of a suspicion of driving under the influence of alcohol, for example. Following the review of the federal standard catalogue of traffic offences and penalties, the significance threshold for traffic offences was set at a fine of €25, as offences penalised with fines above this amount can generally no longer be considered minor infringements (such as parking offences or the like).

Variables acquired from VZR records

The data retrieved from the VZR records yielded the following indicators for driving behaviour relevant to the evaluation:

- The indicator "VZR accidents" (as primary evaluation criterion),
- the indicator "VZR traffic offences" (this includes VZR accidents and thus corresponds to the overall indicator described above),
- the indicator "adjusted VZR offences" as an alternative for special applications; defined as the difference between the two aforementioned indicators (VZR traffic offences excluding VZR accidents).

The indicators follow a concept of driving behaviour based on Section 1 of the German Road Traffic Regulations (SCHADE, 2002): "Participation in road traffic demands constant caution and mutual consideration. Every road user must act such that no other user is harmed or endangered, or otherwise obstructed or inconvenienced to a greater extent than is inevitable under the circumstances." The aspect of lacking caution is covered by the indicator "VZR accidents" (Fig. 4). The aspects of lacking consideration and reliability contribute to the indicator "adjusted VZR offences."

[10] The question of fault for the reported accidents was not addressed in the survey questionnaire. Firstly, this could detract from the respondents' willingness to give honest replies, or may even negatively impact their propensity to participate at all. Secondly, the validity of such information remains questionable even when given by the most honest survey participants. Furthermore, accident statistics collected by the Federal Statistical Office (2009, p. 143) suggest that 18-year-old drivers are at fault in the majority of cases: 73% of the 18 to 20-year-old male drivers and 67% of the female drivers were principally responsible for accidents with injured persons in 2008. As the proportions quoted in the aforementioned statistics drop rapidly with increasing age, it is reasonable to assume that the proportion of cases under review here in which 18-year-old drivers are the principally responsible person (i.e. without consideration of the 19 and 20-year-olds) will be considerably higher still.

Variable	Initial survey	Intermediate survey	Final survey
Socio-demographic data			
Gender	Ek, Kk	-	-
Post code of place of residence (for regional classification)	-	-	Ek, Kk
Educational attainment (level achieved or targeted)	Ek, Kk	-	-
Occupation	Ek, Kk	-	-
Field of occupation (branch)	Ek, Kk	-	-
Educational attainment of parents (highest level)	Ek, Kk	-	-
Road practice before AD17 participation or before obtaining car driving licence			
Possession of other licences	Ek, Kk	-	-
Kilometres travelled with other vehicles	Ek, Kk	-	-
Accidents/traffic offences	Ek, Kk	-	-
Phase of accompanied driving			
Reason for not participating in AD17 model	Kk	-	-
Accompanying person (degree of relationship, gender, age)	Ek	-	-
Kilometres driven per week	Ek	-	-
Driving time per week	Ek	-	-
Available vehicle (age, engine power, owner, user, condition)	Ek	-	-
Accidents/traffic offences	Ek	-	-
Type of roads used	Ek	-	-
Current driving practice			
Available vehicle (age, engine power, owner, user, condition)	Ek, Kk	Ek, Kk	Ek, Kk
Vehicle mileage reading	Ek, Kk	Ek, Kk	Ek, Kk
Kilometres driven per week	Ek, Kk	Ek, Kk	Ek, Kk
Driving time per week	Ek, Kk	Ek, Kk	Ek, Kk
Accidents/traffic offences while using vehicle	Ek, Kk	Ek, Kk	Ek, Kk
Critical traffic situations while using vehicle	-	-	Ek, Kk
Type of roads used	Ek, Kk	Ek, Kk	Ek, Kk
Driving done with/without passengers	-	Ek, Kk	Ek, Kk
Purpose of driving done	-	-	Ek, Kk
Personal attitude to driving			
Assessment of own driving style (e.g. compared to others)	Ek, Kk	-	Ek, Kk
Reasons for vehicle availability	Ek, Kk	-	-
Reasons for vehicle purchase	Ek, Kk	-	-
“Background variables”			
Assessment of driving style of parents	Ek, Kk	-	-
Personality dimensions (‘big six’)	-	Ek, Kk	-
Participation in road safety measures	-	-	Ek, Kk
Duration of absence during the project	-	-	Ek, Kk

Tab. 2: Overview of the variables measured in the initial, intermediate and final surveys for the respective analysis group (Ek, Kk)

The cases counted as accidents include all entries in the records in connection with an accident. To allow for those cases where the entry lacks a so-called accident reference, the categories bodily harm, manslaughter and hit-and-run offences were also evaluated. Only cases of “at-fault accident involvement” were to be taken into account, however. Consequently, purely owner-related and

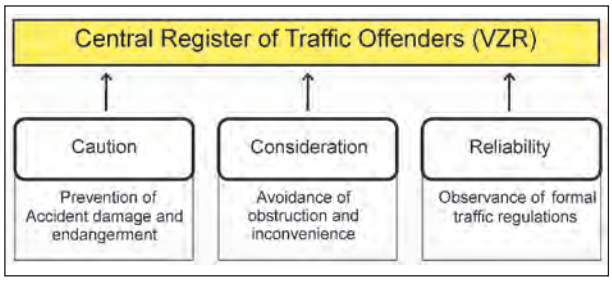

Fig. 4: Scope of information derived from by the Central Register of Traffic Offenders

formal offences with no direct influence on the circumstances leading to an accident were excluded.[11]

2.2 Statistical method

2.2.1 Central statistical hypotheses for the proof of effectiveness

The statistical null hypothesis which must be rejected to furnish proof of effectiveness is: “The persons in the experimental group E display equal or higher rates of accidents and traffic offences compared to the control group K, all control variables remaining constant.” The alternative hypothesis is: “The persons in the experimental group E display lower rates of accidents and traffic offences compared to the control group K, all control variables remaining constant.”

2.2.2 Statistical calculations

Logistic regression

The method of so-called logistic regression is used to determine whether the frequency of a binary (or dichotomised) parameter is dependent on other variables. The so-called dependent variable shows whether an indicator is present or not (“yes/no data”; example: Availability of a vehicle in the household). The regression presents the probability of the dependent variable as a function of the values of so-called independent variables or predictors, e.g. gender, age or educational attainment. To this end, it uses the so-called logistic function in the form (see KLEINBAUM et al., 1998):

$$(1) \quad p(y) = \frac{1}{1+\exp(-z)}$$

In this case, the probability p of an indicator y is to be calculated from the knowledge of k predictors. In this model, the variable z is derived from the linear combination of the k predictors x_1 to x_k:

$$(2) \quad z = \beta_0 + \sum_{j=1}^{k} \beta_j x_j$$

β describes the regression coefficients which are derived in the regression calculations through adaptation of the model and tested for significant deviation from zero.

The variable z relates to the frequently used term "odds”, i.e. the ratio of the probability of an event occurring to the probability of that event not occurring (where “ln” represents the natural logarithm):

$$(3) \quad z = \ln(odds_y) = \ln\left(\frac{p(y)}{1-p(y)}\right)$$

For the purposes of interpretation, the regression coefficient β can be converted with the exponential function exp(β) and describes the ratio of two odds, the so-called “odds ratio” OR:

$$(4) \quad OR_{a,b} = \frac{O_a}{O_b} = \exp(\beta)$$

If β is zero, this means (because exp(0) = 1) that the two compared odds O_a and O_b are equal. If β is for example -0.69, on the other hand, then O_a is only half of O_b (because exp(-0.69) = 0.50). As the regression coefficient contains a statement on a relationship, the choice of the denominator is important, in the chosen example the factor level b. The denominator is generally known as the reference category. Reference categories must be specified accordingly for all predictors.

Instead of the usual odds ratio OR, it is also possible to specify the relative odds difference OD as a percentage: To express the percentage by which O_a is greater than O_b, OR is converted to OD as follows:

(5) OD = 100 (O_a O_b) / O_b = (OR 1) 100

An odds ratio of 1.0, for example, thus means that there is no difference between the odds, while an

[11] Excluded offence codes: A 1 (leaving the scene is not a cause of an accident), A 15 to 19, A 24 and 25 (criminal offences) and K 3, 4, 5, 8, 9, 12 and 14, L 3, 5, 6 and 7, M 3, 4, 5, 7 to 20 and 22 (minor offences)

odds ratio of 1.5 represents a difference in odds of 50%. In the later case, the “risk” or “chance” is higher by 50%.

Poisson regression[12]

To test the central statistical null hypothesis and thereby to furnish proof of effectiveness, the so-called Poisson regression method is used. Poisson regression is a statistical method by which the dependence of count data on influencing factors can be analysed; it is especially suitable for data on rare events with an approximate Poisson distribution (KLEINBAUM et al., 1998, p. 687-705). Alongside the dependent variable (here the number of accidents of an individual) and the influencing factors (here gender or educational attainment, for example), it is possible to consider also a reference value for the counting as a so-called covariate (here the observation period or the distance driven).

The model of Poisson regression is based on two assumptions (here applied to the case of accident figures):

Firstly that the count variable Y, namely the number of accidents per time period of length b, displays a Poisson distribution with the parameter λ, namely the event rate, in every sufficiently homogeneous subset. For a given rate λ and a given period of time b, the probability w of y accidents occurring is calculated as:

$$(6) \quad w(y,b,\lambda) = \frac{(b\lambda)^y e^{-(b\lambda)}}{y!}$$

where e is the base of the natural logarithm.

The expected value for the count variable Y, i.e. the accidents, is thus $b\lambda$; the variance is likewise $b\lambda$.

It is secondly assumed that the rate λ is itself a simple function of the influencing factors, the so-called independent variables x_1, x_2, x_3 ..., combinations of which form the homogeneous subsets. This function is described with:

$$(7) \quad \lambda = e^{(\beta_0+\beta_1 x_1+\beta_2 x_2+\beta_3 x_3+...)}$$

Like any regression analysis, the Poisson regression aims to estimate the dependent variable as accurately as possible on the basis of the influencing factors, i.e. the independent variables. The dependent variable in the present context is the number of accidents in a subset. The estimate is derived from the values x_{1i}, x_{2i}, x_{3i} ... of the influencing factors considered in each subset (e.g. male or female, low or high educational attainment, etc.) as follows

$$(8) \quad \hat{Y}_i = b_i e^{(\beta_0+\beta_1 x_{1i}+\beta_2 x_{2i}+\beta_3 x_{3i}+...)}$$

where b_i is the mean observation period achieved for the subset i. The values β are determined in the regression calculation. They represent the weighting assigned to the individual factor values in order to obtain an optimum estimate. The weighting describes the contribution of each influencing factor to the prediction of accident figures in the sense of regression coefficients. A weighting of zero, for example, means that the presence (or absence) of the factor concerned has no influence on the number of accidents.

This method permits the calculation of standard errors for the coefficients, which in turn enable the calculation of Z scores to test the hypothesis for deviation from zero.

One of the factor levels must be specified as the reference category (the factor “driving licence model”, for example, has the levels E and K); the coefficient of this level is then by definition zero (useful for the K group). The coefficient of the other level (here the E group) indicates the deviation from the reference group. If the coefficient deviates significantly from zero, this can be related to a difference between the factor values (here E compared to K), subject to the applicable probability of error (depending on the chosen significance level). In this case, it could be assumed that the AD17 model exerts an influence on the accident rate.

The extent of the influence can be determined simply by way of the relative risk RR, here the ratio of the accident rate in the E group to that in the K group, using the exponential function “exp” with the regression coefficient β:

$$(9) \quad RR = \exp.(\beta).$$

A relative risk RR = 0.90 in the E group, for example, means that the accident rate is lower by 10% compared to the K group. This case would produce a value for β of -0.105.[13]

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[12] This text is largely based on the explanations of HEINZMANN & SCHADE, 2003, p. 17

[13] because exp(-0.105) = 0.90

The unidirectional effectiveness hypothesis, as alternative to the null hypothesis of "no positive effect", requires a negative regression coefficient and correspondingly a Z score of less than -2.326 (1% level). If the rate of accidents and traffic offences in the E group is higher than in the K group (which would produce a positive regression coefficient), this contradicts the effectiveness hypothesis. In this case, a significance test is superfluous, as the null hypothesis cannot be rejected.

Calculation tools

The present study used the GENLOG procedure from the statistical program package SPSS, version 15, to calculate the Poisson regressions and the LOGISTIC REGRESSION procedure to calculate the logistic regressions. This software was also used for all random selections and data analyses. The analysis of statistical power for the Poisson regressions was performed with the software EGRET.

2.2.3 Sample sizes

Demands placed on statistical power

Given the political importance of the AD17 model, the statistical results of the study must guarantee a sufficiently high level of significance. A probability of error[14] of 5% and a statistical power[15] of 80%, which is often considered adequate for statistical significance tests in scientific publications, is far from acceptable in this context. It is rather necessary to specify a maximum alpha of 1% and a maximum beta of 10% (corresponding to a statistical power of at least 90%).[16]

The required sample size is furthermore dependent on the size of the expected statistical effects under investigation. Small effects call for disproportionately larger samples. To estimate the effects to be expected in this research area, the empirical evidence of other evaluation studies addressing the effectiveness of road safety measures was considered: The Swedish study found a 40% reduction in accidents for accompanied driving (GREGERSEN, 1997). The pilot implementation of the AD17 model in Lower Saxony reported 28% fewer accidents (STIENSMEIER-PELSTER, 2007). Austrian studies on the "L17" early licensing scheme and on the model of a second training phase showed that accidents were reduced by 15% (WINKELBAUER, 2004) and 28% (KALTENEGGER, 2008). A broad appraisal of the literature on evaluations of various models of graduated licensing in the USA and Canada (MAYHEW, 2002) indicates an average accident reduction of 24% (median) across a total of 10 studies and 47 accident indices.

On the basis of this existing experience, the expectation of a 15% accident reduction for the accompanied driving model can be deemed a conservative assumption. The sample sizes were thus planned such that a model-related reduction in accident figures by 15% would be demonstrated with sufficient certainty. It was stipulated that this effect should be identifiable for the primary evaluation criterion, the "accident" indicator. The secondary indicator "traffic offences" and the overall indicator "accidents and traffic offences" were intended to permit generalisation of the results and more in-depth analyses (subgroup comparisons).

Analysis of statistical power

As described above, it was initially assumed that a reduction in accidents of at least 15% was to be demonstrated with a maximum alpha of 1% and a maximum beta of 10% by way of a one-tailed significance test within the framework of a Poisson-regression with three to five control variables (confounds).

For the primary indicator "self-reported accidents", a rough estimate of around 100 to 150 accidents per year per 1,000 18-year-old drivers demanded samples comprising at least 7,200 person-years of observation[17] each for the comparison between the E and K groups. In the case of the indicator "VZR accidents" (to be used to compare silent samples),

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14 Type I error (alpha): Probability that an outcome determined to be significant is a false positive, i.e. it is merely the result of a sampling error.

15 Type II error (beta): Probability that a reduction in accidents and traffic offences (of a certain minimum extent) actually induced by the model is not identified due to a sampling error (false negative), i.e. the effect in the sample does not exceed the chosen threshold.

16 For decisions with far-reaching consequences, it is even appropriate to specify an alpha of 0.1% and a beta of 5%. This would require special justification, however, due to the particularly high demands placed on sample sizes and the resulting costs for the project.

17 Person-years of observation is calculated as the number of persons studied multiplied by the average period of observation per person in years.

a larger sample was required; the much lower basic rate of only 60 assumed record entries per 1,000 persons and year demanded at least 23,600 person-years of observation per group.

As the rate of participation in the contacted groups was difficult to predict, the success of the study relied above all on the silent analysis groups. For this reason, even stricter requirements were defined for the comparisons of the silent samples: Proof of a statistical power of 99% (instead of 90%), i.e. a maximum beta of 1% (instead of 10%), and a very conservative assumption of 40 accidents per 1,000 persons and year (instead of 60). Under these stricter conditions, around 53,000 person-years of observation were necessary per sample.

2.3 Data collection

2.3.1 Sample selection

Participating federal states

The evaluation of the AD17 model considered data from all the federal states which had been participating in the corresponding pilot scheme for at least 12 months at the planned start of the project observation period on 16.03.2007. This was intended to ensure that novice drivers with the maximum period of 12 months of accompanied driving could be found in all the federal states concerned. The criterion was met by 11 states: Bavaria, Berlin, Brandenburg, Bremen, Hamburg, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatinate, Saarland, Saxony and Schleswig-Holstein (see Tab. 3). These states represent 72% of the German population.

Drawing of samples from ZFER

Random samples of the required size were drawn from the Central Register of Driving Licences (ZFER); they comprised persons who met the following selection conditions during the relevant period (“recruitment period”):

- Issuing of a (final) full driving licence for vehicle class B/BE, either as a first licence or as extension of an existing licence for a different vehicle class,
- age between 18 years and 18 years and three months (“early beginners”),
- in case of participation in the AD17 model (experimental group E), a minimum period of participation of three months.

The specification of a suitable and adequate recruitment period faced the serious dilemma that the required numbers of persons for each sample had to be reached within this period: Particularly early dates would have meant that certain federal states could not meet the requirement of at least 12 months participation in the model (Saxony, Berlin and Brandenburg would have had to be excluded from the study). Late dates, on the other hand, would have led to problems regarding the overall project duration. In some federal states, furthermore, the numbers of novice drivers obtaining a driving licence in the conventional manner fell so sharply in favour of AD17

Federal state	Start of AD17 model	Duration on 16.03.07 in months	Included in study?
Lower Saxony	01.04.04	35.5	yes
Bremen	01.06.05	21.5	yes
Hamburg	01.06.05	21.5	yes
Bavaria	01.09.05	18.5	yes
North Rhine-Westphalia	28.09.05	17.5	yes
Schleswig-Holstein	01.10.05	17.5	yes
Rhineland-Palatinate	01.11.05	16.5	yes
Saarland	01.01.06	14.5	yes
Berlin	01.02.06	13.5	yes
Brandenburg	01.02.06	13.5	yes
Saxony	15.03.06	12.0	yes
Hessen	01.10.06	5.5	no
Mecklenburg-Vorpommern	25.11.06	3.5	no
Saxony-Anhalt	01.01.07	2.5	no
Thuringia	01.03.07	0.5	no
Baden-Wuerttemberg	01.01.08	-	no

Tab. 3: Federal states taken into account in the present study, based on the duration of pilot implementation on the project reference date 16.03.2007

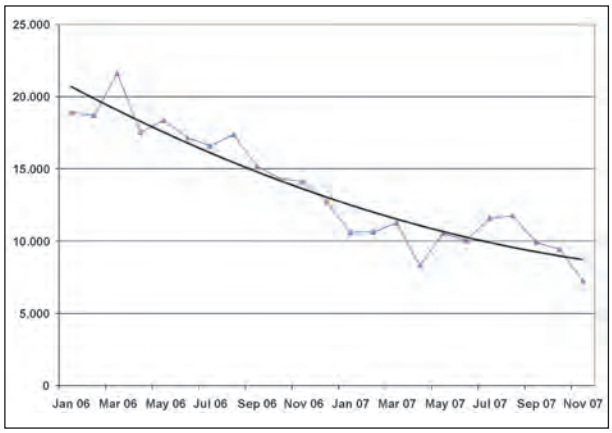

Fig. 5: Conventional driving licences issued per month in the participating federal states

Sample type / group	Recruitment period
Early silent groups (Es1, Ks1) from 10 federal states*	
Bavaria, Bremen, Hamburg, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatinate, Saarland and Schleswig-Holstein	01.01.-15.03.2007 (2.5 months)
Berlin and Brandenburg	01.02.-15.03.2007 (1.5 months)
Contacted group (Ek, Kk) from 11 federal states	16.03.-31.08.2007 (5.5 months)
Late silent groups (Es2, Ks2) from 11 federal states	01.09.-30.11.2007 (3.0 months)
*) without Saxony (5.1% of the German population)	

Tab. 4: Recruitment periods for the different samples

participation (see Fig. 5), that it would no longer have been possible to reach the target figures for the K groups in these states in the second half of 2007.[18]

To comply with the defined conditions, the following solution was found: The recruitment for the silent groups was first divided into an early phase (Es1 and Ks1) and a late phase (Es2 and Ks2). To satisfy the requirement of at least 12 months prior participation in the model for the early groups, it was furthermore necessary to shorten the recruitment period from 2.5 to 1.5 months in the states Berlin and Brandenburg and to forego the participation of the state of Saxony completely (see Tab. 4). At the same time, the late recruitment phase for Es2 and Ks2 had to be shortened from the targeted 24 months to only 15 months in order to accommodate the fixed project duration.

Despite these limitations, the comparability of the resulting individual samples was guaranteed; even though the recruitment and observation periods of the corresponding E and K groups differed between federal states, they remained strictly parallel within each federal state.

Planned sample sizes

For the statistical testing and comparison of the experimental and control groups with Poisson regressions, the sole important parameter is the extent of “exposure”, namely the sum of the observation periods for all participants in a particular group, here termed person-years of observation.[19] On the basis of the planning (see Section 2.2.3), target figures were determined for the observation periods, person-years of observation and net sample sizes (see Tab. 5).

For the contacted groups, the rate of participation had to be estimated as realistically as possible. Such estimates were based on earlier project experience.[20] This experience suggested a spontaneous participation of close to 25% after the first contact and an overall participation of 38% after a reminder. For the present study, a conservative overall participation of 33% after a single reminder was assumed. As most AD17 participants had already given their consent for a

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18 In the federal states Bavaria, Brandenburg, Lower Saxony, Rhineland-Palatinate, Saarland and Schleswig-Holstein, the response to the pilot implementation of the model was by autumn 2007 already so great that 18-year-old drivers obtaining a licence in the conventional manner were in the minority.

19 Alternatively, the reported distances driven could also be taken as the exposure variable, permitting comparisons of groups with equal driving practice.

20 The rate of participation in the BASt project “Accident Data Recorder (UDS)” was very low at only 16% due to the high time demands placed on the participants (e.g. visit to a service centre to have the unit installed). The participation in the BASt project “Effects of the Discontinuation of the Advanced Test in Graduated Motorcyclist Licensing”, on the other hand, was 24% of those contacted, despite the known difficulties with recruitment of this group. The project “Survey of Kilometres Travelled in Germany, 2002” gained the cooperation of 42% of the vehicle owners after the first contact and then 58% after a reminder. In the BASt project “Knowledge of the Road Traffic Regulations”, almost 27% of the contacted vehicle owners returned the 11-page questionnaire without further reminder; after a reminder, this participation was increased to almost 40%. These figures also correspond closely with the experience of the IfeS from the BASt project “Vehicle Use and Risk in the Lifeworld of Young Novice Drivers”.

Sample type / group		Target observation period (months)	Target person-years of observation	Target sample size (net)
Contacted groups, 11 states:	Ek	≥ 12	7,200	10,000*
	Kk	≥ 12	7,200	10,000*
"Early" silent groups, 10 states:	Es1	24	24,000	12,000
	Ks1	24	24,000	12,000
"Late" silent groups, 11 states:	Es2	15	30,000	24,000
	Ks2	15	30,000	24,000
* = for initial survey				

Tab 5: Target figures for the samples (planned)

survey during their first year of participation in the model, and as further favourable conditions could be assumed in their case, the estimate of participation in this group was doubled.

It was nevertheless necessary to correct the above assumptions by a few percentage points, because sampling losses had to be expected: Firstly, a few of the more than 500 licensing authorities did not cooperate with the project to the anticipated extent or in the anticipated quality; secondly, some of the persons to be contacted could not be reached at the specified address or via the specified e-mail address or telephone number; thirdly, a few persons unexpectedly did not meet the selection criteria (e.g. they had not actually participated in the AD17 model).

Given the overall survey period of up to a year, it was additionally necessary to expect a considerable number of drop-outs over time. The drop-out rate between questionnaires for the UDS project was on average 12%. On the cautious assumption of twice as many drop-outs, namely 24% (i.e. only 76% reply), approx. 10,800 persons had to be contacted in each analysis group for the initial survey at the start of the accompanied driving phase; this would achieve the specified target of a total of 7,200 person-years of observation per group within a 12-month observation period.

The following table (Tab. 6) shows the required numbers of cases on the basis of the estimated participation and drop-out rates.

Target figures for participation in the various phases of the study	Ek group (target)	Kk group (target)
Licence numbers drawn from the ZFER and study document packages sent out	19,550	39,100
Persons reached by post	18,182 (93%)	36,364 (93%)
Consent to participation	12,000 (66%)	12,000 (33%)
Completed questionnaires at end of initial survey	10,800 (90%)	10,800 (90%)
E-mail request to participate in intermediate survey	10,800	10,800
Completed questionnaires at end of intermediate survey	8,210, (76%)	8,210, (76%)
E-mail request to participate in final survey	8,210	8,210
Completed questionnaires at end of final survey	6,238, (76%)	6,238, (76%)
Percentages = Proportion of the absolute figure in the table row above		

Tab 6: Required sample sizes for the contacted analysis groups Ek and Kk (target figures based on the described assumptions)

Procedure for the silent analysis groups

To be able to recruit as many participants for the silent analysis groups within the narrowly restricted recruitment period, the drawing of matched samples Es and Ks for each federal state had to be accomplished in several steps:

1. For each federal state, all persons with AD17 participation during the recruitment period were selected from the ZFER (full sample for Es).
2. In each federal state, persons who obtained a driving licence in the conventional manner were also drawn randomly from the ZFER; their number was intended to be equal to the previously drawn Es group (matching of Ks).
3. If the required number of persons for the Ks group was not reached in a particular federal state (see footnote 18), the Es group for this state was reduced accordingly by discarding candidates randomly. After this step, the Es and Ks groups were the same size within each federal state.
4. Further random selection then reduced the various groups to their target size, separately for Es1 and Ks1 on the one hand and Es2 and Ks2 on the other hand.

Procedure for the contacted analysis groups

Details were retrieved from the ZFER for all persons who were issued a full driving licence for vehicle class B/BE (either as a first licence or as extension of an existing licence for a different vehicle class) at an age between 18 years and 18 years and three months during the recruitment period from 16.03.2007 to 31.08.2007. Those persons who (according to the records at the ZFER) had participated in the AD17 model formed the statistical population for the Ek group (N = 72,256). All others formed the population for the Kk group (N = 56,057). The required samples were then drawn randomly from these populations.

Requesting of addresses for the contacted groups from the licensing authorities[21]

Once the samples for the contacted groups had been drawn from the ZFER, the addresses of the relevant persons had to be requested from the individually responsible licensing authorities; addresses are not saved in the central register for reasons of data confidentiality. This required the establishing of contact to each of the over 500 licensing authorities in the participating federal states. The procedure[22] to obtain the addresses comprised the following steps:

- Notification of the highest authorities in the participating federal states,
- information to the directors of all driver licensing authorities, with explanation of the project and a request to name a contact person with e-mail address,
- postal reminder to licensing authority directors who did not reply,
- receipt of e-mail addresses for 410 contact persons from 498 of a total of 536 licensing authorities (i.e. some contact persons were responsible for several authority locations, generally small branch offices),
- E-mail contact to the named contact persons,
- sending of personal identification data (name, first name, date of birth, licence number) for the sample cases to the contact persons at the responsible licensing authorities,
- reminder to contact persons who did not reply,
- receipt of approx. 70,000 addresses returned by 403 contact persons.

In addition, a multitude of questions on the procedure were received by telephone, e-mail or post. The procedure turned out to be unexpectedly complex and time-consuming, with the result that the planned gap of maximum six months between the start of accompanied driving and completion of the initial questionnaire could not be maintained: This period was exceeded for over half of the respondents who participated in the initial survey by completing the online questionnaire.[23]

Subsequently, it was necessary to exclude all sample cases from both the Ek and Kk groups for whom either no valid address was provided (n = 269) or else the address indicated residence abroad (n = 2).

Recruitment of drivers in the contacted analysis groups

Letters were sent to 20,081 drivers in the Ek group and 40,159 drivers in the Kk group with a request to participate in the survey by completing an online questionnaire. Those who wished to participate, but had no access to the Internet, were able to use a

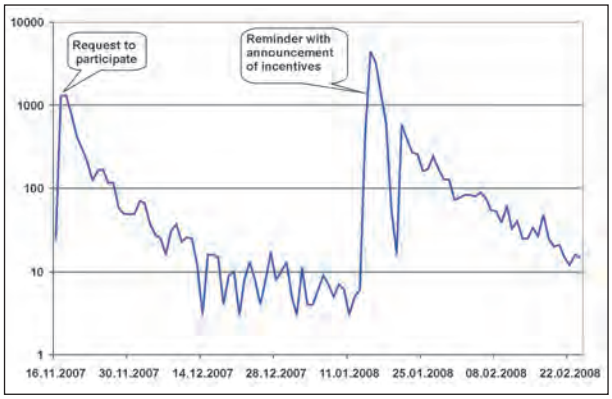

Fig. 6: Rates of daily access to the online questionnaire over time (logarithmic scale)

21 Young drivers were also recruited from four further federal states for cooperation partner IfeS (which performed the formative evaluation), and furthermore for the state of Brandenburg within the framework of a supplementary survey; neither case is a subject of the present report.

22 Regarding the time sequence, see Tab. 8 in Section 2.3.2

23 Further information on the periods is given in Section 3.3. Other reasons for the delay included sluggish response to the questionnaires; higher response was only achieved after the late introduction of originally unplanned incentives (see this page).

prepaid self-addressed card to request a questionnaire by post.

After two months, only 18% of the Ek group and only 10% of the Kk group had responded. In view of this very poor response, "incentives" were announced for survey participants: The opportunity to win a car or one of 99 petrol coupons. A postal reminder with a note pointing to the prize draw promptly led to a sharp increase in the rate of response (see Fig. 6).

2.3.2 Process of the sampling and surveys for the contacted groups

As the recruitment period stretched over five-and-a-half months instead of the originally planned four months, and the initially sluggish first survey took three-and-a-half months, subsequent surveys had to be planned in several waves. To this end, the analysis groups Ek and Kk were divided into four subgroups a to d, reflecting either early or late recruitment and either an early or late initial survey ("group segments", see Tab. 7). It was then possible to specify the dates for the intermediate and final surveys with the aim of avoiding excessively short or long periods between the individual survey waves.

This plan produced three periods for the intermediate surveys ("early", "mid" and "late") and two periods for the final surveys ("early" and "late"). In the case of group segment b, an intermediate survey was deemed unnecessary due to the already short gap between the initial and final surveys (see Tab. 7).

Only those persons who properly completely the online initial questionnaire were asked to participate in the intermediate and final surveys.[24] A request to participate in the final survey was still sent to those persons who did not participate in the intermediate survey.

The requests to participate in the intermediate and final surveys were sent preferably by e-mail, or else by SMS to a mobile phone if this mode of contact had been provided in the initial questionnaire. Around 91% of the respondents provided an e-mail address, 42% a mobile telephone number[25] and

[24] As described in Section 2.1.2, the further evaluation was limited to persons with Internet access.

[25] A remarkable and perhaps characteristic difference was revealed between the group of persons who responded spontaneously to the first request to participate and those who only reacted after a reminder and the announcement of incentives: In the first group, 52% provided a mobile telephone number, compared to only 38% in the second group (significant according to the fourfold chi-squared test).

Group segments:	a ("early"/"early")	b ("early"/"late")	c ("late"/"early")	d ("late"/"late")
Recruitment (Date of start of solo driving)	16.03.-15.06.2007 "early"	16.03.-15.06.2007 "early"	16.06.-31.08.2007 "late"	16.06.-31.08.2007 "late"
Initial questionnaire (Date of reply)	17.11.-31.12.2007 "early"	01.01.-29.02.2008 "late"	17.11.-31.12.2007 "early"	01.01.-29.02.2008 "late"
Intermediate questionnaire (Date of reply)	01.03.-31.03.2008 "early"	not applicable	01.04.-30.04.2008 "mid"	01.05.-31.05.2008 "late"
Final questionnaire (Date of reply)	15.06.-14.07.2008 "early"	15.06.-14.07.2008 "early"	01.09.-30.09.2008 "late"	01.09.-30.09.2008 "late"
Period between recruitment and initial questionnaire	5.0 to 9.0 months	6.5 to 11.5 months	2.5 to 6.5 months	4.0 to 8.5 months
Period between initial and intermediate questionnaire	2.0 to 4.5 months	not applicable	3.0 to 5.5 months	2.5 to 5.0 months
Period between intermediate and final questionnaire	2.5 to 4.5 months	not applicable	4.0 to 6.0 months	3.0 to 5.0 months
Period between initial and final questionnaire	5.5 to 8.0 months	4.0 to 6.5 months	8.0 to 10.5 months	6.5 to 9.0 months
Overall observation period	12.0 to 16.0 months	12.0 to 16.0 months	12.0 to 15.5 months	12.0 to 15.5 months

Tab. 7: Schedule for the surveys of analysis groups Ek and Kk and division into group segments on the basis of the times of recruitment and initial survey

well under 1% neither of the two[26]. If reminders needed to be sent 14 days later, both contact channels were used (where available) to ensure that the person received the request.

The sequence of the individual steps of the survey, from the drawing of samples from the ZFER, via the requesting of addresses from the licensing authorities and recruitment of the participants, to the initial, intermediate and final surveys, including corresponding reminders, is shown in Tab. 8.

The phases of participant recruitment and survey were accompanied by intensive telephone and e-mail contact with the persons concerned. The questions to be answered focussed on general information about the project and the meaningfulness of participation in case of unusual personal circumstances (e.g. temporary stays abroad). A second important aspect was

[26] The latter group (neither mobile telephone nor e-mail address) was consequently only able to participate further in the surveys if they sought information on the forthcoming steps and survey dates by visiting the project website on their own initiative.

Date	Month *	Phase	Action
15.08.07	1.0	A	Letter sent by post to the federal states
24.08.07	1.5	A	Letter sent by post to licensing authorities with no e-mail address
27.08.07	1.5	A	Letter sent by e-mail to licensing authorities with an e-mail address
10.09.07	2.0	A	Reminder sent by post to all licensing authorities
26.09.07	2.5	A	First e-mail contact with the contact persons named by the licensing authorities
05.10.07	2.5	S	Drawing of samples from the ZFER for the groups P#, Ek and Kk (licence numbers)
09.10.07	3.0	A	Excel lists of licence numbers sent by e-mail to the contact persons
19.10.07	3.0	A	Reminder sent by e-mail to the contact persons
30.10.07	3.5	R	Request to participate sent by post to group P#
13.11.07	4.0	R	Request to participate sent by post to groups Ek and Kk
16.11.07	4.0	R	Reminder sent by post to group P#
19.12.07	5.0	R	Requested questionnaires sent by post with note announcing incentives
11.01.08	6.0	R	Reminder sent by post to groups Ek and Kk with note pointing out incentives
31.01.08	6.5	R	Deadline for receipt of postcards requesting a paper questionnaire
21.02.08	7.0	R	Remaining questionnaires sent by post (i.e. those requested by 31.01.08)
29.02.08	7.5	R	Blocking of online questionnaire for initial survey (deadline)
29.02.08	7.5	I	Request to participate in intermediate survey sent by e-mail/SMS to group segment a
13.03.08	8.0	I	Reminder to participate in intermediate survey sent by e-mail/SMS to group segment a
28.03.08	8.5	I	Request to participate in intermediate survey sent by e-mail/SMS to group segment c
07.04.08	8.5	R	Deadline for initial survey questionnaires to be received by post
17.04.08	9.0	I	Reminder to participate in intermediate survey sent by e-mail/SMS to group segment c
30.04.08	9.5	I	Request to participate in intermediate survey sent by e-mail/SMS to group segment d
15.05.08	10.0	I	Reminder to participate in intermediate survey sent by e-mail/SMS to group segment d
18.06.08	11.0	F	Blocking of online questionnaire for the intermediate survey for group segments a and b (deadline)
18.06.08	11.0	F	Request to participate in final survey sent by e-mail/SMS to group segments a and b
02.07.08	11.5	F	Reminder to participate in final survey sent by e-mail/SMS to group segments a and b
01.09.08	13.5	F	Blocking of online questionnaire for the intermediate survey for group segment d (deadline)
01.09.08	13.5	F	Request to participate in final survey sent by e-mail/SMS to group segments c and d
24.09.08	14.0	F	Reminder to participate in final survey sent by e-mail/SMS to group segments c and d
20.10.08	15.0	F	Blocking of online questionnaire for the final survey for all group segments (deadline)

* = Number of months (rounded) since the start of recruitment and questioning in July 2007;
# = AD17 participants still in the phase of accompanied driving (not subject of the present study)
Legend for project phases: A = Address requests to the licensing authorities; S = Sampling;
R = Recruitment of participants and initial survey; I = Intermediate survey; F = Final survey

Tab. 8: Project schedule actually implemented for the analysis groups Ek and Kk

information about the questionnaire. In addition, over one hundred persons contacted the project office to decline the invitation to participate. Further queries addressed technical problems when calling up the online questionnaire.

2.3.3 Retrieval of VZR records

Tab. 9 shows the observation periods for the individual analysis groups.

For all persons included in the study, queries were sent to the VZR on two occasions to determine whether corresponding data records existed: firstly as soon as possible after the start of solo driving (to catch information from the pre-test phase which could otherwise be lost through regular deletion) and then nine months after the end of the observation phase (to include as many delayed entries as possible for offences committed during the post-test phase). Two queries were necessary due to the long project duration, as minor offences are deleted after two years. The nine-month deadline applied individually for all persons, i.e. the evaluation considered only traffic offences committed during the observation period and reported to the VZR within a maximum of nine months after the end of the observation phase.

The first VZR records were retrieved in December 2007 and in February and March 2008. The second round followed in November and December 2009. It was necessary to automate the retrieval for cost reasons; as the results were not screened, there was thus a relatively high proportion of cases (1.1%) which could not be clearly identified[27].

In case of clear identification, all entries relating to the specified person in the period concerned were copied into the research file. Only data relevant to the project study were kept, namely the type of entry and the traffic offence committed.

Group	Observation period
Contacted analysis groups	January 2007 until and including October 2008
Silent analysis groups 1	October 2006 until and including March 2009
Silent analysis groups 2	June 2007 until and including February 2009

Tab. 9: Observation periods (phase of initial solo driving) for the individual analysis groups

[27] Identification here refers to whether or not a record was found for a (single) person with the same date of birth and a sufficiently similar name to that of the person specified.

2.4 Data processing

2.4.1 Data cleaning

The questionnaire data were checked with regard to the usability and plausibility of the responses, as well as to eliminate duplicates.

Persons were to be deleted from both the Ek and Kk data sets if their questionnaires contained more than five invalid responses or else inspection of the contents of their responses identified them as “non-serious participants”. This applied to only one case (E group). A total of 153 duplicates were deleted from the Kk data set; these duplicates were the result of a computer problem at the provider handling the online questionnaire. In 20 cases, duplicates of self-reported traffic incidents with identical or only marginally differing dates and times (full hours) were found in the initial, intermediate and final surveys. As the data were otherwise compatible, these cases were adjusted accordingly.

In some cases, there was significant reason to doubt the correctness of reported mileage readings and weekly driving practice. Mileage readings were treated as invalid if they corresponded to an average vehicle use of less than 800 km or more than 150,000 km per year over the whole lifetime of the vehicle. The reported average driving practice was similarly marked implausible if it exceeded 1,500 km per week, or if consideration together with the number of driving hours per week produced an average speed of less than 5 km/h or more than 150 km/h.

2.4.2 Data preparation

As shown in Tab. 2, certain questions were repeated in each of the individual survey phases, in order to capture any changes in conditions over the duration of the project. This included, for example, the weekly driving practice in kilometres or hours. Before analysis, therefore, the data from the initial, intermediate and final surveys had to be combined into an overall view.

The total driving practice of a driver (in km or hours) over the individual period of participation in the project was calculated by multiplying the weekly distance or driving time with the number of weeks in

each survey phase; these products were subsequently added together.

The average proportions of different road types used during the observation period were obtained from the arithmetic means of the individual survey responses, with the length of each phase serving as a weighting coefficient. A similar approach was taken for the proportions of journeys with and without passengers, and for the age and engine power of the vehicle used in case of a change of vehicle during the project.

For all calculations, the following condition was applied: Data which were missing or implausible in any survey phase were replaced by corresponding valid questionnaire data from the next survey. If these subsequent data were again not present or plausible, the first valid reply was re-used throughout.

The evaluation criteria calculated were the rate of accidents and traffic offences referred to the period and population, namely per 1,000 drivers and year, and the rate of accidents and traffic offences referred to the distance driven, namely per million kilometres.

For an assessment of the representativity of the recruited samples, it is furthermore necessary to consider the regional aspect, in other words the regional origins of the participants. To this end, two regional variables were defined. (1) The place of the responsible licensing authority: Town/city or rural area. This assignment was based on the post code of the authority. (2) The place of residence of the participant: This data was acquired in the final survey and translated into a settlement structure type by way of the post code and the derived statistical ID used by the Federal Office for Building and Regional Planning (BBR). The applicable categories were thus ‘urban (compact settlement)’ and ‘rural (dispersed settlement)’.

3 Realisation of analysis samples

3.1 Quality of addresses for the contacted groups

Of the 524 licensing authorities contacted with the request to provide addresses, 36 either did not reply or else replied too late for the purposes of the

	Persons in the planned sample	Address information received from licensing authority		No address information received from licensing authority	
		Number	in %	Number	in %
Federal state of responsible licensing authority					
Schleswig-Holstein	2,268	2,268	100.0	0	0.0
Hamburg	579	579	100.0	0	0.0
Lower Saxony	11,001	11,000	100.0	1	0.0
Bremen	333	333	100.0	0	0.0
North Rhine-Westphalia	14,094	13,925	98.8	169	1.2
Rhineland-Palatinate	4,878	4,877	100.0	1	0.0
Bavaria	18,861	18,854	100.0	7	0.0
Saarland	1,004	964	96.0	40	4.0
Berlin	1,185	1,185	100.0	0	0.0
Brandenburg	2,823	2,823	100.0	0	0.0
Saxony	3,483	3,432	98.5	51	1.5
Total	60,509	60,240	99.6	269	0.4
Gender of sampled persons					
Male	31,118	30,978	99.6	140	0.4
Female	29,391	29,262	99.6	129	0.4
Total	60,509	60,240	99.6	269	0.4

Tab. 10: Planned and achieved samples by federal state in which the responsible licensing authority was located and by gender

analysis. The overall response rate of 93%, however, was good. The cooperation of the authorities in rural areas (91%) was slightly poorer than in the towns and cities (97%); this was attributed to generally poorer IT facilities and reduced staff availability in rural areas.

The driving licence numbers of the persons drawn for the planned sample groups Ek and Kk (N = 60,509) were sent to the 524 licensing authorities with the request to add the corresponding postal addresses. Information was not provided or else provided too late for only 269 persons, i.e. 0.4% of the total sample (Tab. 10). Non-responses were attributable almost exclusively to the federal states Saarland (4.0%), Saxony (1.5%) and North Rhine-Westphalia (1.2%), but remained negligible (individual rates in brackets). The proportions of male and female persons for whom no information was received were identical at 0.4% in both cases.

The stratification of the planned samples by federal state was based on the office location of the responsible licensing authority. As shown by Tab. 11, the driving licence numbers provided were occasionally assigned addresses in a different federal state to that of the licensing authority, in some cases even in federal states not participating in the project.[28] However, Tab. 11 also shows that the resulting shifts in the samples were minimal.

Federal state	Offices of licensing authority	Place of residence (post code)
Schleswig-Holstein	2,268	2,289
Hamburg	579	561
Lower Saxony	11,000	10,975
Bremen	333	336
North Rhine-Westphalia	13,925	13,912
Hessen	-	5
Rhineland-Palatinate	4,877	4,866
Baden-Wuerttemberg	-	13
Bavaria	18,854	18,814
Saarland	964	956
Berlin	1,185	1,185
Brandenburg	2,823	2,816
Saxony	3,432	3,429
Saxony-Anhalt	-	5
Thuringia	-	2
could not be determined	-	76
Total	60,240	60,240

Tab. 11: Persons contacted by the federal state in which the responsible licensing authority was located and by place of residence according to the address provided

Of the more than 60,000 letters sent out to the sampled persons, 1,278 were returned as undeliverable; that corresponds to a rate of only 2.1%.

Conclusion

A sufficiently large number of addresses of “early beginners” was achieved; this sample can be considered a genuinely random sample from all participating federal states. There were no significant sample distortions between federal states, between urban and rural regions or between the two gender groups.

3.2 Willingness to participate in the contacted groups

Tab. 12 provides an overview of the cases taken into account in the following analysis.

As already explained in Section 2.3.1, the participation after the first round of postal contact was totally insufficient. It was thus deemed necessary to send out reminders together with an announcement of an attractive prize draw. This raised the participation sharply from 18 to 47% in the Ek group and from 10 to 27% in the Kk group (Tab. 13), although 7% of those who responded by calling up the online questionnaire and even over 23% of those who asked for a questionnaire to be sent by post did not participate in the end. As

Sample size*	N = 62,919
Contact medium	Letter by post
Analysis groups	Ek (21,780), Kk (41,139)
Analysis period	Contact to request participation in initial survey
* = including a parallel special survey of 2,679 persons from Brandenburg	

Tab. 12: Analysis conditions and number of cases relevant for the first part of Section 3.2

[28] Hessen: 2 addresses in the E group, 3 in the K group; Baden-Wuerttemberg: 7 addresses in the E group, 6 in the K group; Saxony-Anhalt: 5 addresses in the K group; Thuringia: 2 addresses in the K group; in 76 cases, automatic identification of the federal state from the post code of the place of residence was not possible.

Analysis group:	Ek*	Kk*
First postal contact with request to participate (achieved sample*)	21,780	41,139
Participants after first contact	3,911	4,121
Participation after first contact	18.0%	10.0%
Reminder with announcement of incentives	17,869	37,018
Total participants after reminder (respondent sample)	10,235	11,175
Total participation after reminder	47.0%	27.2%
Online questionnaires completed	9,393	10,277
Paper questionnaires completed	842	898
Online questionnaires as a proportion of all completed questionnaires	91.8%	92.0%
Paper questionnaires as a proportion of all completed questionnaires	8.2%	8.0%
Participation by online questionnaire as a proportion of all those persons who called and viewed the questionnaire on the Internet	93.4%	92.5%
Participation by paper questionnaire as a proportion of all those persons who requested such a questionnaire	77.3%	75.9%
* = including a parallel special survey in Brandenburg		

Tab. 13: Numbers of participants* and rates of participation in the initial survey for the analysis groups Ek and Kk

Sample size	N = 60,240
Data source	Paper and online questionnaires
Analysis groups	Ek (20,081), Kk (40,159) excluding special survey in Brandenburg
Analysis period	Request to participate in initial survey

Tab. 14: Analysis conditions and number of cases relevant for the remainder of this section

expected (see Section 2.1.2), the proportion of Internet users in the target group of "early beginners" was very high at approx. 92% of all survey respondents.

A comparable postal survey conducted by the Dresden University of Technology and the German motorists club ADAC in 1999 recorded a particularly high participation. A multiple-page questionnaire was sent to 5,000 novice licence holders who had acquired test ADAC membership (STERN & SCHLAG, 2001): The participation was there 41% compared to 34% (taking an average over all groups) for the present study.

For the further analysis, the cases belonging to the special survey in Brandenburg were no longer taken into account (Tab. 14).

The findings in Tab. 15, indicate that cooperative project participants, i.e. persons who properly completed the full online or paper questionnaire, differ from the non-responders in terms of both gender and the federal state in which the responsible licensing authority is located. The differences are each highly significant (gender: chi-square = 466.2, df = 1, $p < 0.001$; federal state: chi-square = 62.2, df = 10, $p < 0.001$).

While the female participation of 38.1% was still satisfactory, only 29.7% of the young men contacted were motivated to participate (Tab. 15). This resulted in a shift in the gender proportions between the original and net samples: The proportion of male drivers fell from the envisaged 51.4% to 45.2%.

The northern federal states Schleswig-Holstein and Hamburg achieved the highest participation rates (37.6% and 36.1%, respectively), whereas Saarland, Bremen and Bavaria reached only around 31 to 32%. Whilst the differences are statistically significant, they do not lead to an important distortion of the sample: In the federal state with the greatest deviation, namely Schleswig-Holstein, the achieved sample was 11% larger than the target; by contrast, Saarland remained 9% below the target figure. The deviations in all other federal states were between +7% and -6% of the individual target.

The responsible licensing authorities were categorised according to the regional structure at their office locations, namely into the groups 'urban' (town/city) and 'rural'. In both cases, the contacted persons displayed similar willingness to participate; the minor difference of 0.7 percentage points is not significant (chi-square = 2.34, df = 1, $p = 0.129$).

Of the 18,762 persons who completed the online questionnaire of the initial survey phase, 3,748 made use of the comment box. Discounting comments with less than four characters (often "emoticons") and furthermore all replies which simply declined the invitation to give a comment, 3,559 entries remained (19% of all respondents). The overwhelming majority expressed considerable interest and serious commitment to the survey, though some respondents also criticised details of the questionnaire.

	Number of persons in achieved sample		Project participants			Project non-responders		
	Number	in % (column)	Number	in % (column)	in % (row)	Number	in % (column)	in % (row)
Gender								
Male	30,957	51.4	9,203	45.2	29.7	21,754	54.5	70.3
Female	29,283	48.6	11,143	54.8	38.1	18,140	45.5	61.9
Total	60,240	100.0	20,346	100.0	33.8	39,894	100.0	66.2
Federal state of responsible licensing authority								
Schleswig-Holstein	2,268	3.8	853	4.2	37.6	1,415	3.5	62.4
Hamburg	579	1.0	209	1.0	36.1	370	0.9	63.9
Lower Saxony	11,000	18.3	3,689	18.1	33.5	7,311	18.3	66.5
Bremen	333	0.6	106	0.5	31.8	227	0.6	68.2
North Rhine-Westphalia	13,925	23.1	4,872	23.9	35.0	9,053	22.7	65.0
Rhineland-Palatinate	4,877	8.1	1,750	8.6	35.9	3,127	7.8	64.1
Bavaria	18,854	31.3	6,068	29.8	32.2	12,786	32.0	67.8
Saarland	964	1.6	295	1.4	30.6	669	1.7	69.4
Berlin	1,185	2.0	401	2.0	33.8	784	2.0	66.2
Brandenburg	2,823	4.7	937	4.6	33.2	1,886	4.7	66.8
Saxony	3,432	5.7	1,166	5.7	34.0	2,266	5.7	66.0
Total	60,240	100.0	20,346	100.0	33.8	39,894	100.0	66.2
Regional structure of responsible licensing authority								
Town/city	47,513	78.9	15,975	78.5	33.6	31,538	79.1	66.4
Rural area	12,727	21.1	4,371	21.5	34.3	8,356	20.9	65.7
Total	60,240	100.0	20,346	100.0	33.8	39,894	100.0	66.2

Tab. 15: Project participants and non-responders at the time of the initial survey by gender and by the federal state and regional structure of the responsible licensing authority

Conclusion

The announcement of an attractive prize draw raised the initially low participation to the targeted level: Around one-third of the contacted persons completed the initial questionnaire; 92% of them used the Internet.

The differences in participation between federal states were, whilst statistically significant, only slight: The percentage deviations of the net achieved samples from their targets in the federal states generally remained in single figures. There was no difference in the participation between rural areas and the towns and cities. The only factor which led to considerable differences in participation and thus to a distortion of the net sample was gender: Instead of the required proportion of 51% male drivers, only 45% responded. Consequently, it became necessary to include gender as a control variable in the evaluation, particularly since gender is known to correlate closely with road traffic participation and traffic offences.

Analysis group:	Ek	Kk
Valid questionnaires (net sample)	9,521	10,825
Online questionnaire	8,785	9,977
Paper questionnaire	736	848

Tab. 16: Valid questionnaires from the initial survey phase of the present study (i.e. excluding the special survey in Brandenburg)

The numbers of respondents whose questionnaires were finally included in the present study are shown in Tab. 16. The targeted minimum of 10,800 respondents with valid questionnaires per group was just exceeded in the Kk group; in the Ek group, on the other hand, the final figure fell short of the target by 12 per cent. For the analysis plan, however, the number of participants is less important than the actual observation period (see following section).

3.3 Achieved sample sizes and observation periods in the contacted groups

The following analysis refers only to those study participants who were actually considered in the outcome evaluation, namely the respondents to the online survey. Tab. 17 provides an overview of the cases which are relevant for the analysis in this section.

Realised timing of the survey

The following tables and figures show the actual intervals between the start of solo driving and the initial survey, and furthermore between the individual survey phases (Tab. 18 to Tab. 21 and Fig. 7 to Fig. 10). The time at which a participant submitted the online questionnaire is treated as the time of survey.

Sample size	N = 18,762
Data source	Online questionnaire (18,762)
Analysis groups	Ek (8,785) and Kk (9,977)
Analysis period	Initial, intermediate and final questionnaires

Tab. 17: Analysis conditions and number of cases relevant for Section 3.3

Months	Ek group	Kk group	Total
Mean	7.0	6.7	6.8
Standard deviation	1.9	1.8	1.9
Median	7.0	6.6	6.8
90th percentile	9.7	9.3	9.5
Minimum	2.6	2.6	2.6
Maximum	13.4	11.1	13.4

Tab. 18: Interval in months between the start of solo driving and completion of the initial questionnaire

Months	Ek group	Kk group	Total
Mean	3.8	3.8	3.8
Standard deviation	0.6	0.6	0.6
Median	3.6	3.6	3.6
90th percentile	4.5	4.5	4.5
Minimum	2.0	1.0	1.0
Maximum	6.7	7.0	7.0

Tab. 19: Interval in months between completion of the initial and intermediate questionnaires (only persons with intermediate questionnaire survey, i.e. group segments a, c and d in Tab. 7)

The results can be summarised as follows: In most cases, 3 to 4 months passed between the initial and intermediate questionnaires and between the intermediate and final questionnaires. In 10% of the cases, however, the intervals exceeded 4.5 or even 5.0 months. In group segment b (see Tab. 7), where no intermediate questionnaire was completed due to the late date of the initial survey, the interval between the initial and final questionnaires was mostly 4 to 5 months; in 10% of the cases, however, more than 5.6 months passed. With only a few exceptions, it was thus possible to meet the demanded maximum interval of 6 months between questionnaires.

This demand was less well met for the interval between the start of solo driving (i.e. the start of the observation period) and the initial questionnaire. This interval was in most cases 5 to 8 months, but in 10% of the cases more than 9.3 (Kk group) or even 9.7 months (Ek group), attributable to the

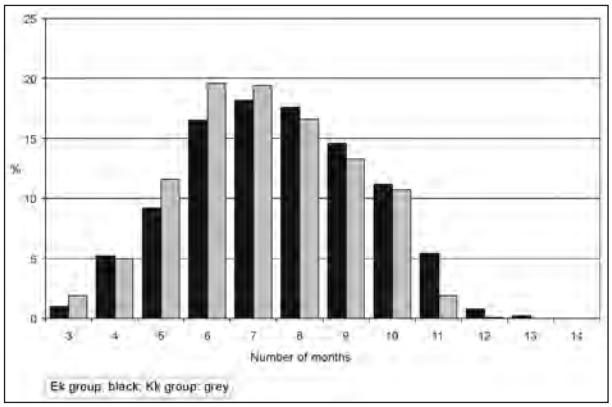

Fig. 7: Interval in months (rounded upwards) between the start of solo driving and completion of the initial questionnaire (as a percentage of all initial survey respondents)

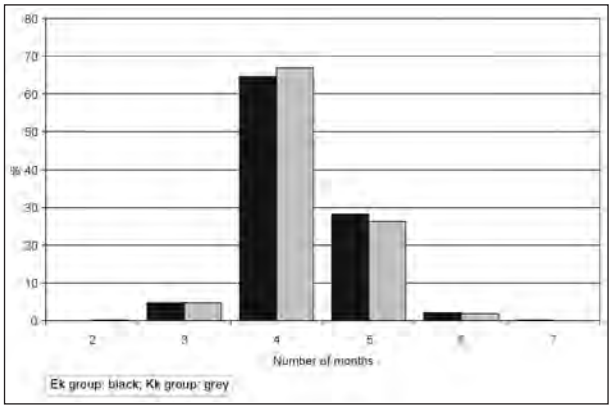

Fig. 8: Interval in months (rounded upwards) between completion of the initial and intermediate questionnaires (only persons with intermediate questionnaire, i.e. group segments a, c and d in Tab. 7) (as a percentage of all intermediate survey respondents)

distinct disadvantage of an excessively long address procurement and recruitment period (cf. Tab. 8).

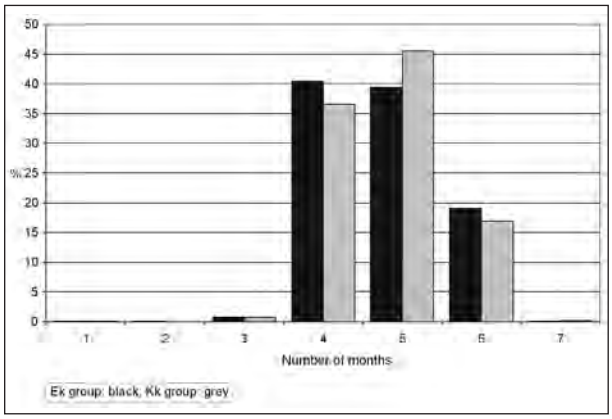

Fig. 9: Interval in months (rounded upwards) between completion of the intermediate and final questionnaires (only persons with intermediate and final questionnaires, i.e. group segments a, c and d in Tab. 7) (as a percentage of all final survey respondents)

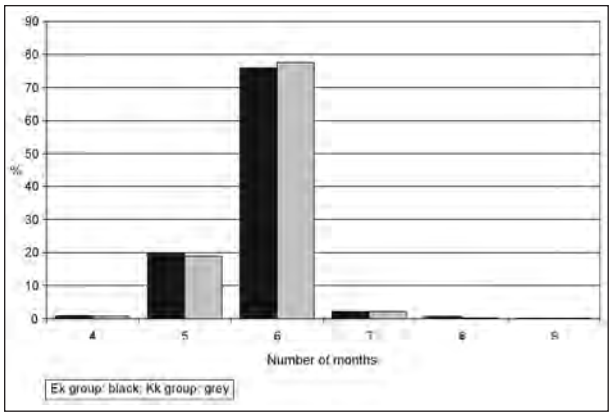

Fig. 10: Interval in months (rounded upwards) between completion of the initial and final questionnaires (only persons without intermediate but with final questionnaire, i.e. group segment b in Tab. 7) (as a percentage of all final survey respondents)

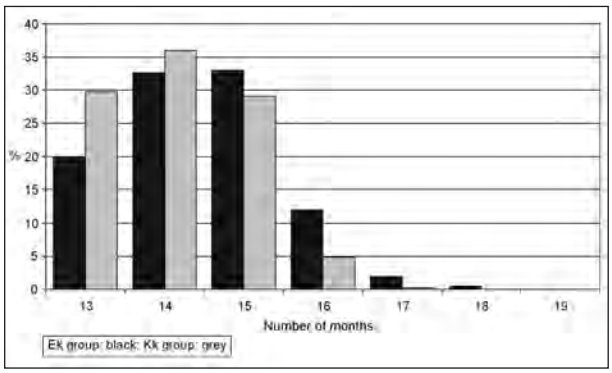

Fig. 11: Interval in months (rounded upwards) between the start of solo driving and completion of the final questionnaire (as a percentage of all final survey respondents)

The observation period between the start of solo driving and the initial questionnaire was approx. 1.5 weeks (5%) longer for the Ek group than for the Kk group. This must be taken into account in period-based interpretations. With the exception of this difference at the start of the observation phase, there were no practically relevant differences between the groups in respect of the intervals between questionnaires.

The difficulties encountered with address procurement (see Section 2.3.1) gave rise to fears that the target observation periods would not be reached. When the survey plan was drawn up, the date for the final survey was therefore chosen such that (in the worst case) there would still be at least

Months	Ek group	Kk group	Total
Mean	4.2	4.2	4.2
Standard deviation	0.7	0.6	0.6
Median	4.1	4.1	4.1
90th percentile	5.0	5.0	5.0
Minimum	0.1	0.4	0.1
Maximum	6.5	6.3	6.5

Tab. 20: Interval in months between completion of the intermediate and final questionnaires (only persons with intermediate and final questionnaires, i.e. group segments a, c and d in Tab. 7)

Months	Ek group	Kk group	Total
Mean	5.2	5.2	5.2
Standard deviation	0.4	0.4	0.4
Median	5.1	5.1	5.1
90th percentile	5.6	5.6	5.6
Minimum	3.6	3.6	3.6
Maximum	8.7	8.6	8.7

Tab. 21: Interval in months between completion of the initial and final questionnaires (only persons without intermediate but with final questionnaire, i.e. group segment b in Tab. 7)

Months	Ek group	Kk group	Total
Mean	13.9	13.6	13.7
Standard deviation	1.0	0.9	1.0
Median	13.9	13.5	13.7
90th percentile	15.2	14.8	15.0
Minimum	12.0	12.0	12.0
Maximum	18.3	18.1	18.3

Tab. 22: Interval in months between the start of solo driving and completion of the final questionnaire

12 full months of observation (preferably 13 or 14 months). Fig. 11 and Tab. 22 show that all cases fulfilled the requirement of a minimum observation period of 12 months. The observation period was actually 13.7 months on average, and even longer than 15 months in 10% of the cases. At the time of the final survey, therefore, practically all respondents were between 19 and 19.5 years of age, and most replied during the first quarter after their 19th birthday.

In addition to the post-test phase described here, the observation period also included a 12-month pre-test phase, i.e. the year before the start of solo driving.

Achieved participation and sample sizes in the individual survey phases

1. Intermediate survey: As the time between the initial and final surveys was very short in some cases, the intermediate survey was not sent to all participants (only to group segments a, c and d in Tab. 7). Furthermore, the intermediate survey addressed only those participants who had completed the online questionnaire as part of the initial survey; the same applied to the final survey.

Both the initial request to complete an intermediate questionnaire and the subsequent reminder contained a clear notice that the prize draw was only open to those who participated through to the final survey. Nevertheless, the participation in the intermediate survey was only 70% (Tab. 23) and thus slightly lower than expected (76 %). The intermediate survey was not essential for the evaluation; it served above all to maintain contact with the participants and to record information on critical incidents before they were forgotten.

2. Final survey: The participation was even lower in the group segment which was asked to complete the final questionnaire without having participated in the intermediate survey. Despite the announcement of a prize draw, only 61% replied. Overall, 67% participated in the final survey (compared to the expected 76%). Among those who had already completed the intermediate survey, the participation was 88%; by comparison, only 26% of those who had declined the intermediate survey returned the final questionnaire.

The participation among previous AD17 participants was on average two to three percentage points higher than that of persons with a driving licence obtained in the conventional manner. This difference is small, but can nevertheless be seen as first indication of a certain "self-selection effect" in this group; this must be taken into account in the evaluation.

For further analyses, the following three levels of "compliance" (willingness to participate) are relevant:[29]

Analysis group:	Ek	Kk	Total
Initial questionnaire			
Participants after reminder	8,785	9,977	18,762
Intermediate questionnaire			
Asked to participate by e-mail or SMS: Group segments a, c, d	5,685	6,378	12,063
Participants after reminder	4,033	4,444	8,477
Participation in %	70.9	69.7	70.3
Final questionnaire			
1. Persons without planned intermediate survey			
Asked to participate by e-mail or SMS: Group segment b	3,100	3,599	6,699
Participants after reminder	1,969	2,121	4,090
Participation in %	63.5	58.9	61.1
2. Persons with participation in intermediate survey			
Asked to participate by e-mail or SMS: Group segments a, c, d	4,033	4,444	8,477
Participants after reminder	3,598	3,898	7,496
Participation in %	89.2	87.7	88.4
3. Persons who declined the intermediate survey			
Asked to participate by e-mail or SMS: Group segments a, c, d	1,652	1,934	3,586
Participants after reminder	454	492	946
Participation in %	27.5	25.4	26.4
4. Totals (Persons 1 to 3)			
Asked to participate by e-mail or SMS: All group segments	8,785	9,977	18,762
Participants after reminder	6,021	6,511	12,532
Participation in %	68.5	65.3	66.8

Tab. 23: Numbers of participants and participation rates in the individual survey phases (after reminder)

[29] It was decided to forego definition of a fourth level, namely participation in all three surveys, as the intermediate survey (whilst useful for minimising memory effects) was not absolutely integral to the analysis design (see Section 2.1.2).

Analysis group / Compliance level	Ek	Kk	Total
Level 1: "Drop-outs" after initial survey	2,331	2,922	5,253
Level 2: "Drop-outs" after intermediate survey	433	544	977
Level 3: "Stayers" with final survey	6,021	6,511	12,532
Total	8,785	9,977	18,762
Proportion of "stayers" as percentage of the total	68.5	65.3	66.8

Tab. 24: Numbers of persons who dropped out after the initial or intermediate survey or else participated through to the final survey (compliance levels 1 to 3)

Level 1: Participation in initial survey only ("Drop-outs 1"),

Level 2: Participation in the initial and intermediate surveys, but not in the final survey ("Drop-outs 2"),[30]

Level 3: Participation in the initial and final surveys ("Stayers"), irrespective of participation in the intermediate survey.[31]

Tab. 24 shows the numbers of persons at each compliance level. The approx. 6,000 and 6,500 "stayers" were close to the minimum figure demanded per group (namely 6,238, see Tab. 6). As many aspects of the evaluation can also consider data from "drop-outs", the seemingly narrow result nevertheless meets the requirements.

Achieved observation periods

As explained in Section 2.2.3, the total years of observation are of greater importance for the outcome evaluation than the numbers of participants alone. At least 7,200 person-years of observation (or 86,400 person-months) were required per group. Tab. 25 shows that the "stayers" alone exceeded the target figure by 2% in the Kk group, while the Ek group fell 3% short of the target.

Analysis group / Compliance level	Ek	Kk	Total
	Person-months of observation		
Level 1: "Drop-outs" after initial survey	17,512	20,929	38,442
Level 2: "Drop-outs" after intermediate survey	4,248	5,127	9,375
Level 3: "Stayers" with final survey	83,923	88,381	172,303
Total	105,683	114,437	220,120
Proportion of "stayer-months" in per cent	79.4	77.2	78.3

Tab. 25: Numbers of person-months of observation (sum of the periods – in months – from the start of solo driving to the specified survey for all persons), differentiated by compliance levels 1 to 3

When the observation periods of the "drop-outs" were included, however, the total duration of observation was even 22 to 32% longer than the required minimum.[32] Overall, the present study achieved an observation period of more than 18,000 person-years (Tab. 25).

Conclusion

The intervals between survey questionnaires were generally kept below six months, as intended. The time between the start of solo driving and the first survey, on the other hand, was on average seven months and thus slightly longer than planned. The targeted total observation period of at least 12 months per person was achieved in all cases and on average even exceeded by around 7 weeks.

The written requests, reminders and prize draw announcements led to an overall participation rate of 34%. In other words, 18,762 young drivers supplied a valid initial survey questionnaire. Of these, 70% participated in the intermediate survey and 67% in the final survey. The questionnaires thus covered a total of more than 18,000 years of first-year driving experience for a representative sample of young novice drivers. The sample sizes and observation periods required for a statistical outcome evaluation were thus met (cf. the demands in Section 2.2.3).

3.4 Socio-demographic composition of the contacted groups

The socio-demographic composition of the Ek and Kk analysis groups is reflected in the following tables (Tab. 27 to Tab. 31) by way of the factors

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30 Not all respondents to the initial survey were asked to participate in the intermediate survey; group segment b according to Tab. 7 did not participate for time reasons (see Section 2.3.2).

31 see footnote 30

32 This positive result (despite the lower-than-planned numbers of participants) is due to the longer recruitment and initial survey phase, which also delayed the final survey; this meant that an average 13.7 months of observation were recorded per person compared to the planned 12 months (see Tab. 22).

Sample size	N = 20,346
Data sources	Online questionnaire (18,762), Paper questionnaire (1,584)
Analysis groups	Ek (9,521) und Kk (10,825)
Analysis period	Initial survey

Tab. 26: Analysis conditions and number of cases relevant for Section 3.4

Gender and regional structure	Ek in %	Kk in %
Proportion of female drivers	55.7	53.9
Proportion of male drivers	44.3	46.1
Total	100	100
Proportion resident in urban areas	74.9	76.7
Proportion resident in rural areas	25.0	23.1
Could not be determined	0.1	0.2
Total	100	100
N =	9,521	10,825

Tab. 27: Gender of the drivers and regional structure of the place of residence (urban/rural according to post code) in the analysis groups

gender, regional structure at the place of residence (based on post code), school education or occupation, and the educational attainment of the driver's parents. Tab. 26 shows the cases taken into account in the present section.

All differences found were small (up to only six percentage points), but are nevertheless statistically significant at the 1% level (chi-square tests) due to the large samples. The Ek and Kk groups are thus very similar in their socio-demographic composition, but cannot be considered strictly homogeneous. The biggest differences (more than four percentage points) for persons of the Ek group compared to persons in the Kk group included:

- They were more frequently still attending school,
- those still at school were more frequently planning to obtain an advanced certificate,
- those who were already out of school had less frequently moved on to vocational training,
- at least one parent had more frequently obtained a university degree.

As the later exploration of educational attainment was not intended to make a general distinction between targeted and attained education status, the two variables were combined into a single new

Attained and targeted school certificate	Ek in %	Kk in %
School attendance		
Still attending school	62.2	56.1
Already out of school	37.8	43.8
not specified	0.0	0.1
Total	100	100
N =	9,518	10,813
Persons still attending school: Certificate targeted		
Special-school certificate	0.0	0.0
Basic-level or qualified basic-level certificate	0.1	0.2
Secondary-level certificate	1.4	2.4
Advanced-level certificate (continuation from secondary level)	4.6	5.7
Discipline-specific advanced-level certificate	7.2	10.3
General advanced-level certificate	85.5	79.7
Other	1.3	1.7
not specified	0.1	0.1
Total	100	100
N =	5,919	6,077
Persons already out of school: Certificate attained		
None	0.2	0.3
Special-school certificate	0.2	0.1
Basic-level certificate	7.0	9.8
Qualified basic-level certificate	9.0	11.7
Secondary-level certificate	63.7	65.4
Advanced-level certificate (continuation from secondary level)	7.5	5.5
Discipline-specific advanced-level certificate	5.6	4.2
General advanced-level certificate	5.9	2.1
Other	1.0	0.8
Total	100	100
N =	3,648	4,814

Tab. 28: Attained and targeted school certificates in the analysis groups Ek and Kk

variable “attained or targeted school certificate” (Tab. 29). This variable is more easily comparable with the results of other studies.

A comparison of the socio-demographic indicators with those of similar studies reveals a slight selection effect in favour of female gender and higher educational attainment in the present evaluation: FUNK and GRÜNINGER (2010, Chapter 3.5) reported a proportion of 52% females

Attained or targeted school certificate	Ek in %	Kk in %
None	0.1	0.1
Special-school certificate	0.1	0.1
Basic-level certificate	2.7	4.4
Qualified basic-level certificate	3.5	5.2
Secondary-level certificate	25.2	30.3
Advanced-level certificate (continuation from secondary level)	5.6	5.6
Discipline-specific advanced-level certificate	6.5	7.5
General advanced-level certificate	55.3	45.5
Other	0.7	0.8
not specified	0.4	0.4
Total	100	100
All persons N =	9,521	10,825

Tab. 29: Attained or targeted school certificate in the analysis groups Ek and Kk

Occupation status of persons already out of school	Ek in %	Kk in %
Vocational training (apprenticeship)	72.7	77.1
Student	6.2	2.7
Military or community service	2.6	1.4
Unemployed	2.3	3.9
Employed	8.4	9.0
not specified	7.9	5.8
Total	100	100
All persons N =	3,895	5,045

Tab. 30: Occupation status of persons already out of school, by analysis group

in their sample of AD17 drivers (n = 3,780) compared to 50% in a sample of 18-year-olds in their mobility study (n = 2,389; FUNK, SCHNEIDER, ZIMMERMANN & GRÜNINGER, 2010). The present evaluation, on the other hand, returns proportions of 56% for female AD17 drivers and 54% for female drivers with a licence obtained in the conventional manner (n = approx. 10,000 in each case). With regard to attained or targeted school certificates, FUNK and GRÜNINGER (2010, Tab. 3-8) report a proportion of 63% with an advanced-level certificate in the sample of AD17 drivers and 54% in the sample of 18-year-olds in their mobility study. The corresponding figures for the present evaluation are 67% for AD17 drivers and 59% for drivers with a licence obtained in the conventional manner.

Highest educational attainment of parents or legal guardians	Ek in %	Kk in %
Schooling completed without certificate	0.2	0.5
Special-school certificate	0.0	0.0
Basic-level certificate (or formerly equivalent 8 or 9-year school education)	13.6	14.9
Secondary-level certificate (or formerly equivalent 10-year school education)	35.5	37.0
General advanced-level certificate, including continuation from secondary level (or formerly equivalent 12-year school education)	17.4	16.5
University or college degree	28.0	23.6
Other	1.4	2.0
"Don't know"	3.8	5.5
not specified	0.1	0.1
Total	100	100
All persons N =	9,521	10,825

Tab. 31: Highest educational attainment of parents or legal guardians, by analysis group

A slightly more education-oriented background among novice drivers who choose an accompanied driving model had already been found in Sweden (GREGERSEN, 1997, p. 31): The parents of these novice drivers had more frequently obtained a college or university degree (46.8%) than the parents of novice drivers undergoing conventional driver training (38.4%).

Conclusion

When compared to other equivalent studies, the sample analysed here displays a slight selection effect (approx. four percentage points) in favour of female gender and higher educational attainment.

The (former) participants in the AD17 model tended to report a higher educational attainment compared to those who obtained their driving licence in the conventional manner. The difference of around five percentage points is statistically significant but can nevertheless be considered of minor importance. The difference between the two groups in terms of gender and the regional structure at their place of residence (urban/rural) were likewise statistically significant, but of even less relevance.

In the interest of a strict analysis method, however, these differences between the two analysis groups are still to be subjected to critical evaluation in the course of the present study; both factors are known to carry substantial weight with regard to road traffic participation and traffic offences.

3.5 Achieved sample sizes and observation periods in the silent groups

Tab. 32 shows the sizes of the samples drawn from the ZFER for the silent analysis groups, together with the achieved observation periods during the post-test phase. Cases where the VZR records did not permit clear identification (persons with exceptionally similar names and same date of birth) were not considered.

For all groups, the observation period included also a 12-month pre-test phase, i.e. the year before the start of solo driving.

Analysis group	Sample size	Observation period during post-test phase
Es1	13,787	24 months
Ks1	13,792	24 months
Es2	23,787	15 months
Ks2	23,751	15 months
Total	75,117	

Tab. 32: Achieved sample sizes and observation periods in the silent analysis groups

4 Preliminary analysis of possible bias of survey results

Before tackling the core research questions of the questionnaire survey, it is necessary to clarify a number of methodological points arising from the chosen study design. It is necessary to ascertain whether any intentional or unintentional effects may bias the survey results and thus limit the generalisability and interpretation of its results. Such bias may result from systematic influences, namely:

- The intended limitation to respondents with Internet access (possible challenge: Persons without Internet access would have replied differently),
- the chosen incentivisation (a prize draw) as motivation to participate (possible challenge: Persons who only participate in the hope of winning a prize are not representative),
- increasing participant drop-out rate (resulting from diminishing compliance over time), which means that not all respondents to the initial survey also complete the final questionnaire (possible challenge: Persons who display particular stamina are not representative),
- self-selection effects due to the voluntary nature of the survey (possible challenge: Persons who participate voluntarily in surveys on driving behaviour are those with no unsafe behaviour to report; they are thus not the cause of the problem the AD17 model seeks to address),
- the possibility of pre-existing fundamental differences between AD17 participants and those obtaining a licence in the conventional manner with regard to vehicle availability, vehicle use or general attitudes to driving, i.e. a self-selection effect relating to the model (possible challenge: Such differences already explain the differences in driving behaviour between the two groups).

4.1 Limitation to persons with Internet access

The possibility to request a paper version of the questionnaire by post allowed all those who were interested to participate in the initial survey, irrespective of whether they had access to the Internet or not. For cost reasons, however, it was necessary to conduct the subsequent intermediate and final surveys exclusively as online surveys. This meant that 7.8% of the original participants were excluded from the further evaluation (see bottom row in Tab. 34).

Even though a clear majority of approximately 92% of the respondents chose the online questionnaire, the exclusion of persons without Internet access could lead to a systematic bias of the analysis samples. This would be the case, for example, if those who requested a paper questionnaire also had less frequent access to a vehicle and were furthermore more frequently in the control group. Limitating survey participation to persons with Internet access would in this (fictive) case reduce the comparability of the experimental and control groups in subsequent analyses.

Influences which shift the gender proportions or the levels of educational attainment in the analysis groups, however, can be compensated to a certain extent: The factors “gender” and “educational attainment”, which arguably have the greatest impact on the behaviour of interest in the current

Sample size	N = 20,346
Data sources	Online questionnaire (18,762), Paper questionnaire (1,584)
Analysis groups	Ek (9,521) and Kk (10,825)
Analysis period	Initial survey

Tab. 33: Analysis conditions and number of cases

study, are included as control variables in all further analyses.

Tab. 33 shows the study sample analysed in this section.

It is first analysed how important characteristics of the samples change if the persons without Internet access are removed from the sample (Tab. 34). The table shows the proportions of participants with a driving licence obtained in the conventional manner (Kk group), male gender and higher educational attainment[33], separately for users of the online and paper questionnaires. The differences are negligibly small, with one exception: Far fewer users of the paper questionnaire report higher educational attainment (approx. 40%) than users of the online questionnaire (65%). Nevertheless, removing persons without Internet access from the sample does not result in any major shift: The proportion of persons with higher educational attainment in the reduced sample (-7.8%) increases by only two percentage points – an acceptable shift, particularly as the influence of educational attainment is to be controlled through suitable statistical methods in all subsequent analyses.

The study of Internet use by KORUPP, KÜNEMUND und SCHUPP (2006) mentioned in Section 2.1.2 indicated significantly lower use by persons with low educational attainment and by female respondents. The present results do not suggest a major influence of gender: The shift in gender proportions in favour of male respondents after removing the users of the paper questionnaire is only 0.2 percentage points (Tab. 34).

The question remains, whether the removal of respondents without Internet access results in a bias which affects on the comparability of the E and K groups (separately from the aforementioned variables AD17 or conventional driving licence

Variable Persons with …	Persons using …			Shift due to limitation to online questionnaire
	Online questionnaire	Paper questionnaire	Total	
Conventional driver training	53.2%	53.5%	53.2%	±0.0%-points
Male gender	45.4%	43.2%	45.2%	+0.2%-points
Higher educational attainment*	65.0%	40.1%	63.0%	+2.0%-points
Total number of persons	18,762	1,584	20,346	-7.8%
* = Advanced-level school certificate (see also footnote 33)				

Tab. 34: Shifts in the survey sample after limitation to response by online questionnaire

model, gender and educational attainment). Formulated in statistical terms, this relates to the following questions:

1. Do important behaviour determinants reveal a statistical interaction between the driving licence model and response medium (Internet versus paper-based) after accounting for the effect of the control variables? If so, the removal of paper questionnaires would affect the Ek and Kk samples to a different extent and would thus reduce the comparability of the two groups.

2. Do important behaviour determinants reveal a so-called statistical main effect for the factor response medium (Internet versus paper)? If so, the removal of paper-based responses would lead to a shift in the sample composition. Provided there is no interaction as described in point 1, however, this case would not affect the study as the Ek and Kk groups would be similarly impacted and would thus remain comparable.

As the proportion of paper questionnaires is small at almost 8%, any bias according to point 1 or shift according to point 2 would need to be very pronounced for the exclusion of this subsample to result in a noticeable qualitative change in the sample composition.

To test these statistical questions, the response alternatives for all variables included in the initial questionnaire as behaviour determinants were condensed to leave just two response options in each case (“dichotomised”).

[33] As many of the respondents were still attending school at the time of the survey, no distinction is made here between a targeted and actually attained school certificate.

These simplified variables are subsequently used as so-called dependent variables in a logistic regression model, a statistical method serving to demonstrate statistical main effects and interactions in frequency data (see Section 2.2.2). The method uses sets of independent variables, namely the factors response medium, driving licence model, gender and educational attainment to predict each dependent variable. For this purpose, the analysis assumes a simplified model which takes into account all main and two-way interaction effects; three- and four-way interactions are not considered, however, based on the assumption that these are not significant.

A separate logistic regression with the factors response medium, driving licence model, gender and educational attainment was calculated for each behaviour determinant measured in the initial questionnaire (see Tab. 35). All calculated regression coefficients which indicated a main effect for the factor response medium or an interaction of this factor with the factor driving licence model were tested for statistical significance. Given the multitude of tests (60) and the associated inflation of the (hitherto applicable) maximum alpha of one per cent, the testing was carried out nominally at a 0.1 per cent level.

Despite the sufficiently large samples, none of the tested interactions was found to be significant. Consequently, the discarding of persons without Internet access appears to affect the sample composition in the Ek and Kk groups in essentially the same manner, if at all. There is thus no evidence of a sample bias between the analysis groups as a result of the exclusion of respondents without internet access.

There are nevertheless a number of significant main effects, i.e. the users of the online questionnaire differ systematically from the users of the paper questionnaire in respect of certain variables (Tab. 35): Internet users were more frequently themselves the owner of their primarily used vehicle. This applied especially to those persons who did not specify an advanced-level school certificate as their actual or targeted educational attainment. Users of the online questionnaire more frequently reported a high proportion of driving in built-up areas compared to the users of the paper questionnaire; their driving practice on roads outside built-up areas (excluding motorways), on the other hand, was lower. That means that Internet users tended to drive more within built-up areas than outside, which could indicate a more urban population. It is also consistent with town-dwellers with a good traffic infrastructure that Internet users emphasised mobility as an important vehicle function slightly less strongly. Indeed, 73.6% of the Internet users live in “urban regions”[34] compared to only 62.0% of those who used the paper questionnaire.

A very noticeable difference was found between the two groups in weekly driving practice, both in terms of distance driven and driving time: Users of the paper questionnaire more frequently reported a distance driven of more than 200 km and a driving time of more than 4 hours per week. This difference may again be attributable in part to the lower frequency of an urban place of residence in this sample.

A further difference between the users of electronic and postal communication was that the Internet users described themselves less frequently as “more attentive” in traffic when comparing themselves to others.

One of the greatest differences between the groups related to the educational attainment of the respondent's parents: Internet users more frequently specified a higher educational attainment for their parents than the users of the paper questionnaire (43.6% versus 30.1%, respectively). This significant difference is particularly remarkable, since the methodology of the regression model used already controls for the educational attainment of the respondent in its calculations. The parents' educational attainment thus influences not only the education of their children, but also Internet access. In other words, the parents co-determine whether or not the household installs an Internet connection.

Even though three of the eight significant variables display a difference of more than 10 percentage points, the overall change in the composition of the sample due to the exclusion of persons without Internet access is minor. A pre-post comparison of the proportion of parents with higher educational attainment reveals an increase of only one per cent, namely from 42.6% in the original sample to 43.6% after exclusion of respondents without Internet access. For the other variables, the shift is smaller still. The exclusion of persons without Internet access can thus be accepted without detriment for the study.

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[34] Determined by way of their address post code

Conclusion

Despite systematic differences between the users of the online and paper questionnaires, the decision to exclude survey respondents without Internet access (a step required for cost reasons) does not significantly affect the sample composition. There is in particular no sample bias between the analysis groups Ek and Kk, which could impair their comparability and reduce the stringency of the evaluation.

Dependent variable: **Factor addressed in initial survey** **(in brackets: Value considered)**		**No information given**	**N**	**Reply by online questionnaire**	**Reply by paper questionnaire**
Sample size			20,346	18,762	1,584
Previous practice with a road vehicle other than a car (more than 10 km)		0.0%	20,346	-	-
Age of the primarily used vehicle (over 9 years)		18.6%	16,565	-	-
Engine power of the primarily used vehicle (more than 50 kW)		11.5%	18,013	-	-
Owner of the primarily used vehicle (self)	advanced-level school* below advanced-level school*	7.1%	18,909	23.2% 58.0%	19.0% 41.7%
Main user of the primarily used vehicle (self)		7.8%	18,769	-	-
Technical condition (TÜV) of the primarily used vehicle (with defects)		8.1%	18,708	-	-
Further vehicles in the household (yes)		8.1%	18,693	-	-
Weekly driving practice (from 200 km)		1.6%	20,018	32.6%	49.8%
Driving time per week (more than 4 hours)		0.0%	20,346	32.6%	44.8%
Percentage of driving on motorways (more than 33%)		0.7%	20,212	-	-
Percentage of driving outside built-up areas (more than 50%)		0.3%	20,279	19.3%	25.2%
Percentage of driving in built-up areas (more than 50%)		0.3%	20,284	34.5%	26.7%
Driving style: Safe (affirmed)		0.0%	20,346	-	-
Driving style: Sporty (affirmed)		0.0%	20,346	-	-
Driving style: Calm and composed (affirmed)		0.0%	20,346	-	-
Appreciation of the vehicle: Mobility (affirmed)		0.0%	20,346	85.8%	94.4%
Appreciation of the vehicle: Fun (affirmed)		0.0%	20,346	-	-
Reason for vehicle purchase decision: Performance (affirmed)		0.0%	20,346	-	-
Reason for vehicle purchase decision: Consumption (affirmed)		0.0%	20,346	-	-
Reason for vehicle purchase decision: Utility value (affirmed)		0.0%	20,346	-	-
Reason for vehicle purchase decision: Safety (affirmed)		0.0%	20,346	-	-
Comparison with others: Safer (affirmed)		0.0%	20,346	-	-
Comparison with others: More cautious (affirmed)		0.0%	20,346	-	-
Comparison with others: More attentive (affirmed)		0.0%	20,346	60.4%	66.5%
Comparison with others: More willing to comply with traffic rules (affirmed)		0.0%	20,346	-	-
Father's compliance with traffic rules (affirmed)		4.8%	19,371	-	-
Mother's compliance with traffic rules (affirmed)		5.7%	19,181	-	-
Father's driving style described as sporty (affirmed)		5.6%	19,210	-	-
Mother's driving style described as sporty (affirmed)		7.2%	18,887	-	-
Educational attainment of parents (advanced school certificate or higher)		4.8%#	20,346	43.6%	30.1%

* = Attained or targeted school certificate; # = Failure to provide information was treated as a negative reply
- = Not shown as no significant difference; N = Remaining sample size for the individual analysis

Interpretation example: Among the survey respondents with or planning to obtain an advanced-level school certificate, 23.2% of those who replied via the online questionnaire were themselves owner of the primarily used vehicle, compared to 19.0% of those who used the paper questionnaire.

Tab. 35: Significant differences remaining between persons replying to the initial survey by online or paper questionnaire after prior adjustment for gender, educational attainment and driving licence model

4.2 Effect of incentives

The announcement of "incentives", namely a draw with valuable prizes as reward for respondents to the survey, resulted in a sharp increase in participation to more than double the initial figure (cf. Tab. 13). This could prove a problem for the comparability of the E and K analysis samples if the mechanisms of such self-selection affect the individual groups differently (fictitious example: The incentive of being able to win a car is especially high for young drivers with no car of their own, and such drivers are found more frequently in the K group than the E group). It would then be necessary to consider not only the different analysis groups Ek and Kk, but also the different motivation of the respondents, namely spontaneous participation before the announcement of incentives ("intrinsically motivated") or participation after the announcement of incentives ("extrinsically motivated").

To test this, all respondents who completed the full online questionnaire were classified as intrinsically or extrinsically motivated, depending on whether the date of their participation was before or after the date of announcement of the prize draw.[35] The following analyses are based solely on information provided by online questionnaire, as only these replies are to be considered in the final evaluation (regarding the number of applicable cases, see Tab. 36).

The first step was to determine how the sample composition changed in terms of the independent variables after the announcement of incentives. The incentives attracted especially the participation of persons with educational attainment below an advanced-level school certificate, persons with a driving licence obtained in the conventional manner (Kk group) and male respondents (see Tab. 37). The proportions of these groups in the overall sample increased by five to six percentage points. This is a success, because these are all groups which would otherwise have been under-represented in the survey. For example, the gender composition of the analysis samples changed as follows: The target was a male proportion of 47.9% for the Ek group, of 53.2% for the Kk group and thus of 51.4% overall. The announcement of incentives contributed to the finally achieved proportion of male respondents of 45.4%, which was considerably closer to the target.

The proportion of persons with a driving licence obtained in the conventional manner, which should ideally be 50%, was initially lower. As a result of the introduction of incentives, this target was eventually slightly exceeded. It can thus be concluded that the announcement of incentives had a different effect on the two analysis samples: It met with a greater response in Kk group, which had previously been under-represented.

To uncover potential systematic biases relating to important driving behaviour determinants (e.g. vehicle availability or driving style), similar analyses to those described in Section 4.1 were performed as a second step; this served to reveal whether these determinants were influenced by the factors "driving licence model" (AD17 versus conventional) and "motivation" (intrinsic versus extrinsic). In statistical terms, the questions were thus:

1. Do important behaviour determinants reveal statistical interactions between the driving licence model and the motivation of the

Sample size	N = 18,762
Data source	Online questionnaire (18,762)
Analysis groups	Ek (8,785) and Kk (9,977)
Analysis period	Initial survey

Tab. 36: Analysis conditions and number of cases

Variable	Sample		Change (percentage points)
	before incentive announcement	after incentive announcement	
Male gender	40.1%	45.4%	+5.3%
Lower educational attainment*	29.2%	35.0%	+5.8%
Conventional driver training (Kk group)	47.5%	53.2%	+5.7%
Total persons	5,474	18,762	+243%
* = less than advanced-level school certificate (see footnote 33)			

Tab. 37: Changes in the survey sample after the announcement of incentives (users of online questionnaire only)

[35] A slight imprecision in the date used means that approximately one per cent of the respondents classified as extrinsically motivated are misclassified; this figure is acceptable as it has absolutely no impact on the conclusions.

respondent when the control variables gender and educational attainment are taken into account? If so, the motivation would affect the E and K samples to a different extent and would thus reduce the comparability of the two groups.

2. Do important behaviour determinants reveal a so-called statistical main effect for the factor motivation? If so, the announcement of incentives would have led to a change in the sample composition. Provided there is no interaction as described in point 1, however, this would not affect the study results as the E and K groups would be impacted in a similar way and would thus remain comparable.

Separate logistic regressions with the factors gender, educational attainment, driving licence model and motivation as independent variables were calculated for each behaviour determinant included in the initial questionnaire. All regression coefficients which indicated a main effect for the factor motivation or an interaction of the factor motivation with the factor driving licence model were tested for statistical significance. Given the multitude of tests (60) and the associated inflation of the (hitherto applicable) maximum alpha of one per cent, testing was carried out nominally at a 0.1 per cent level.

Despite the sufficiently large samples, none of the tested interactions between the factors motivation and driving licence model was found to be significant. The self-selection of respondents as a result of the incentives therefore appears to affect the samples in the Ek and Kk groups in essentially the same manner, despite the slight preference towards the Kk group (see above). There is thus no evidence to suggest a sample bias between the analysis groups due to the prize draw.

To be able to recognise an equivalent shift in the samples of both groups, the main effects of the factor motivation were analysed. Of the 30 variables considered, three displayed significant differences between the extrinsically and intrinsically motivated respondents (Tab. 38), even though the already identified differences attributable to gender, educational attainment and driving licence model were taken into account statistically in the regression calculations: 41.4% of the extrinsically motivated male respondents (i.e. those who agreed to participate only after announcement of the incentives) were themselves owner of the vehicle used, compared to only 34.7% of the intrinsically motivated male respondents, whereas there was practically no difference in this variable between extrinsically and intrinsically motivated female respondents. It is remarkable that the owners of a vehicle were especially enticed by the opportunity to win a new car; another possible interpretation is that this group is actually more interested in the prospect of petrol vouchers. Another remarkable point is that the parents of the extrinsically motivated respondents were more frequently perceived as conscientious in their compliance with road traffic rules than the parents of the intrinsically motivated respondents.

Conclusion

The (very effective) announcement of incentives resulted in a significant change in sample composition. The absolute extent of the change, however, was small: A pre-post comparison revealed shifts of only three to five percentage points. Three of the factors were actually shifted in a desirable direction: The incentives attracted the participation of more male respondents, more persons with lower educational attainment and more persons with a driving licence obtained in the conventional manner, in other words groups which would otherwise have been slightly under-represented.

When all variables are taken into account, the change in sample composition is negligibly small. The essential effect of the prize draw announcement was the (intended) considerable increase in the numbers of participants and expansion of the spectrum of participants involved.

There is in particular no bias between the analysis groups Ek and Kk in terms of the essential behaviour determinants vehicle use and attitude to driving; this would otherwise impair the comparability of the two groups and reduce the stringency of the evaluation.

Dependent variable: Factor addressed in initial survey (in brackets: Value considered)		No information or vehicle	N	Extrinsically motivated	Intrinsically motivated
Sample size			18,762	13,288	5,474
Previous practice with a road vehicle other than a car (more than 10 km)		0.0%	18,762	-	-
Age of the primarily used vehicle (over 9 years)		20.0%	15,010	-	-
Engine power of the primarily used vehicle (more than 50 kW)		12.1%	16,488	-	-
Owner of the primarily used vehicle (self)	male female	7.6%	17,341	41.4% 67.9%	34.7% 68.1%
Main user of the primarily used vehicle (self)		8.1%	17,234	-	-
Technical condition (TÜV) of the primarily used vehicle (with defects)		8.6%	17,155	-	-
Further vehicles in the household (yes)		8.8%	17,118	-	-
Weekly driving practice (from 200 km)		1.3%	18,519	-	-
Driving time per week (more than 4 hours)		0.0%	18,762	-	-
Percentage of driving on motorways (more than 33%)		0.0%	18,762	-	-
Percentage of driving outside built-up areas (more than 50%)		0.0%	18,762	-	-
Percentage of driving in built-up areas (more than 50%)		0.0%	18,762	-	-
Driving style: Safe (affirmed)		0.0%	18,762	-	-
Driving style: Sporty (affirmed)		0.0%	18,762	-	-
Driving style: Calm and composed (affirmed)		0.0%	18,762	-	-
Appreciation of the vehicle: Mobility (affirmed)		0.0%	18,762	-	-
Appreciation of the vehicle: Fun (affirmed)		0.0%	18,762	-	-
Reason for vehicle purchase decision: Performance (affirmed)		0.0%	18,762	-	-
Reason for vehicle purchase decision: Consumption (affirmed)		0.0%	18,762	-	-
Reason for vehicle purchase decision: Utility value (affirmed)		0.0%	18,762	-	-
Reason for vehicle purchase decision: Safety (affirmed)		0.0%	18,762	-	-
Comparison with others: Safer (affirmed)		0.0%	18,762	-	-
Comparison with others: More cautious (affirmed)		0.0%	18,762	-	-
Comparison with others: More attentive (affirmed)		0.0%	18,762	-	-
Comparison with others: More willing to comply with traffic rules (affirmed)		0.0%	18,762	-	-
Father's compliance with traffic rules (affirmed)		4.9%	17,847	58.6%	51.6%
Mother's compliance with traffic rules (affirmed)		5.9%	17,661	74.1%	69.5%
Father's driving style described as sporty (affirmed)		5.7%	17,697	-	-
Mother's driving style described as sporty (affirmed)		7.4%	17,381	-	-
Educational attainment of parents (advanced school certificate or higher)		4.8%#	18,762	-	-

# = Failure to provide information was treated as a negative reply; - = Not shown as no significant difference;
N = Remaining sample size for the individual analysis

Interpretation example: 41.4% of the extrinsically motivated male survey respondents were themselves owner of the primarily used vehicle, compared to 34.7% of the intrinsically motivated respondents.

Tab. 38: Significant differences remaining between intrinsically and extrinsically motivated respondents to the initial survey after prior adjustment for gender, educational attainment and driving licence model

4.3 Survey drop-outs

If the participants who drop out of a long-term study are predominantly those with reservations or a generally negative attitude towards the subject of the study, for example, then systematic distortion of the results can be expected. It is therefore necessary to investigate the correlation between "compliance" (the willingness to participate) and the survey results (regarding the cases included, see Tab. 39).

Sample size	N = 18,762
Data source	Online questionnaire (18,762)
Analysis groups	Ek (8,785) and Kk (9,977)
Analysis period	Initial, intermediate and final surveys

Tab. 39: Analysis conditions and number of cases

The three levels of compliance distinguished in Section 3.3 are here condensed into a fundamental distinction between "drop-outs" and "stayers". A drop-out is defined as a person who participated in the initial survey (and possibly also the intermediate survey), but did not respond in the final survey. Stayers, on the other hand, are those persons who participated in both the initial and final surveys (irrespective of possible failure to respond to the intermediate survey). The relevant numbers of persons are shown in Tab. 24.

The procedure followed was identical to that used in the previous section to test the influence of the incentives, except that the factor compliance replaced the factor motivation. The first step was to determine how the sample composition changed in terms of the independent variables as a result of the drop-outs (see Tab. 40). Drop-outs were found to lead in particular to a decrease in the proportion of persons with educational attainment below the level of an advanced school certificate (-4.6 percentage points); likewise to a reduced proportion of male respondents (-1.5 percentage points) and persons with a driving licence obtained in the conventional manner (-1.2 percentage points). There were thus fewer persons with higher educational attainment, fewer female respondents and fewer former AD17 participants among the drop-outs (FUNK and GRÜNINGER, 2010, Chap. 3.4, reach the same conclusion regarding gender and educational attainment; AD17 participation was not subject of their study).

The above changes meant that precisely those shifts in the sample induced by the announcement of incentives (see previous section) were partially reversed. This could suggest that those persons who were only willing to participate if incentives are offered (extrinsically motivated) displayed a greater tendency to terminate participation prematurely. There is indeed a significant difference (fourfold chi-square test: Chi = 439.4; df = 1): 22.0% of the intrinsically motivated respondents dropped out, compared to 37.8% of the extrinsically motivated respondents (those particularly attracted by the prize incentive).

Variable	Sample		Change (percentage points)
	before	after	
	drop-outs		
Proportion of males	45.4%	43.9%	-1.5%
School certificate below advanced level (see footnote 33)	35.0%	30.4%	-4.6%
Conventional driver training (Kk group)	53.2%	52.0%	-1.2%
Total sample	18,762	12,532	-33.2%

Tab. 40: Shifts in the survey sample due to drop-outs

As a second step, analyses were performed to uncover possible systematic biases relating to important driving behaviour determinants (e.g. vehicle availability or driving style); it was tested whether these determinants themselves correlated with the factors "driving licence model" (AD17 versus conventional) and "compliance" (drop-out versus stayer). In statistical terms, the questions were thus:

1. Do important behaviour determinants reveal statistical interactions between the driving licence model and compliance when the control variables gender and educational attainment are taken into account? If so, the drop-outs would not be distributed equally between the Ek and Kk groups and would thus limit their comparability.

2. Do important behaviour determinants reveal a so-called statistical main effect for the factor compliance? If so, the drop-outs would lead to a change in the sample composition. Provided there is no interaction as described in point 1, however, this case would not affect the study results: The Ek and Kk groups would be similarly affected and would thus remain comparable.

Separate logistic regressions with the factors gender, educational attainment, driving licence model and compliance as independent variables were calculated for each behaviour determinant included in the initial questionnaire. All calculated regression coefficients which indicated a main effect for the factor compliance or an interaction of this factor with the factor driving licence model were tested for statistical significance. Given the multitude of tests (60) and the associated inflation of the (hitherto applicable) maximum alpha of one per cent, testing was carried out nominally at a 0.1 per cent level.

Despite the sufficiently large samples, none of the tested interactions between the factors compliance and driving licence model was found to be significant. The premature termination of participation thus appears to affect the samples in the Ek and Kk groups in essentially the same manner, despite the slightly higher rate in the Kk group (see above). There is thus no evidence to suggest a sample bias between the analysis groups due to the drop-outs.

To be able to recognise an equivalent shift in the samples of both groups, the main effects of the factor compliance were analysed alongside its interactions with the control variables. Of the 30 variables considered, ten revealed significant

Dependent variable: **Factor addressed in initial survey** **(in brackets: Value considered)**	**Sample size**	**No information or vehicle**	**N** **18,762**	**Stayers** **12,532**	**Drop-outs** **6,230**
Previous practice with a road vehicle other than a car (more than 10 km)	male female	0.0%	18,762	29.5% 13.1%	40.0% 14.5%
Age of the primarily used vehicle (over 9 years)		20.0%	15,010	-	-
Engine power of the primarily used vehicle (more than 50 kW)		12.1%	16,488	-	-
Owner of the primarily used vehicle (self)	advanced-level school* below advanced-level school*	7.6%	17,341	22.0% 57.8%	26,4% 58,3%
Main user of the primarily used vehicle (self)		8.1%	17,234	56.5%	65.8%
Technical condition (TÜV) of the primarily used vehicle (with defects)		8.6%	17,155	-	-
Further vehicles in the household (yes)		8.8%	17,118	-	-
Weekly driving practice (from 200 km)		1.3%	18,519	29.5%	38.7%
Driving time per week (more than 4 hours)		0.0%	18,762	30.3%	37.1%
Percentage of driving on motorways (more than 33%)		0.0%	18,762	-	-
Percentage of driving outside built-up areas (more than 50%)		0.0%	18,762	19.8%	18.3%
Percentage of driving in built-up areas (more than 50%)		0.0%	18,762	-	-
Driving style: Safe (affirmed)		0.0%	18,762	-	-
Driving style: Sporty (affirmed)		0.0%	18,762	24.9%	29.3%
Driving style: Calm and composed (affirmed)		0.0%	18,762	61.8%	56.8%
Appreciation of the vehicle: Mobility (affirmed)		0.0%	18,762	-	-
Appreciation of the vehicle: Fun (affirmed)		0.0%	18,762	-	-
Reason for vehicle purchase decision: Performance (affirmed)		0.0%	18,762	-	-
Reason for vehicle purchase decision: Consumption (affirmed)		0.0%	18,762	-	-
Reason for vehicle purchase decision: Utility value (affirmed)		0.0%	18,762	-	-
Reason for vehicle purchase decision: Safety (affirmed)		0.0%	18,762	-	-
Comparison with others: Safer (affirmed)		0.0%	18,762	-	-
Comparison with others: More cautious (affirmed)		0.0%	18,762	-	-
Comparison with others: More attentive (affirmed)		0.0%	18,762	-	-
Comparison with others: More willing to comply with traffic rules (affirmed)		0.0%	18,762	-	-
Father's compliance with traffic rules (affirmed)		4.9%	17,847	55.2%	59.5%
Mother's compliance with traffic rules (affirmed)		5.9%	17,661	-	-
Father's driving style described as sporty (affirmed)		5.7%	17,697	-	-
Mother's driving style described as sporty (affirmed)		7.4%	17,381	-	-
Educational attainment of parents (advanced school certificate or higher)		4.8%#	18,762	46.1%	38.7%

* = Attained or targeted school certificate; # = Failure to provide information was treated as a negative reply
- = Not shown as no significant difference; N = Remaining sample size for the individual analysis
Interpretation example: 29.5% of the male stayers reported previous practice of more than 10 km with a motor vehicle other than a car, compared to 40.0% of the male drop-outs.

Tab. 41: Significant differences remaining between drop-outs and stayers among respondents to the initial survey even after adjustment for gender, educational attainment and driving licence model

differences between the stayers and drop-outs (Tab. 41), even though the already identified differences attributable to gender, educational attainment and driving licence model were already taken into account as controls in the regression calculations.

Of the male drop-outs, 40% had prior practice with another vehicle, compared to just 30% of the male stayers. Among the female respondents, on the other hand, there was practically no difference in this respect between the drop-outs and stayers. Among the persons with educational attainment at the level of an advanced school certificate or higher (compared to those with lower educational attainment), there was a noticeable difference between drop-outs and stayers with regard to vehicle ownership: The drop-outs with higher educational attainment were more frequently themselves owner of the vehicle used. The drop-outs were also more often the principal user of the vehicle. At the same time, the drop-outs more frequently reported driving practice of over 200 km and driving time over four hours compared to the stayers. They furthermore more frequently affirmed a sporty driving style and negated a calm and composed driving style. They more frequently described their parents as conscientious drivers (significant only for fathers). Finally, with regard to the educational attainment of the parents, drop-outs specified a slightly lower proportion of higher educational attainment.

Conclusion

The premature termination of participation resulted in a significant change in sample composition. The absolute extent of the change, however, was small. The differences between stayers and drop-outs were up to nine percentage points for certain variables; however, the difference of interest here, namely between the original sample and the final sample without drop-outs, amounts to only about one-third of this figure.[36] These shifts of between one and three percentage points are considered negligible.

Furthermore, the slight shifts in the sample with regard to vehicle use and driving style are the same in both the Ek and Kk groups. This means that (from the methodological perspective) there is no bias attributable to drop-outs which could impair the comparability of the two groups and reduce the stringency of the evaluation.

4.4 Influence of the intermediate survey

As explained in Sections 2.1.2 and 2.3.2, a proportion of the participants was asked to complete an intermediate questionnaire, namely wherever the intervals between surveys would otherwise have exceeded six months.

It could be objected that persons participating in an intermediate survey are better able to recall past traffic incidents and that they would report more accidents and traffic offences for this reason alone. The cases considered are shown in Tab. 42.

Poisson regressions (see Section 2.2.2) were used to test whether participation in the intermediate survey (with the control variables driving licence model, gender, educational attainment, place of residence, parental role model and vehicle availability) was associated with a higher rate of self-reported accidents and traffic offences.[37]

The results indeed showed that the rate of traffic offences for persons who participated in the intermediate survey was higher by 7.7%. This figure, however, falls short of the required significance level of 1.0 per cent (one-sided test, p = 0.026; not significant). In the case of accidents, the annual rate was only 1.4% higher (one-sided test, p = 0.386; not significant).

Sample size	N = 12,528
Data source	Online questionnaire
Analysis groups	Ek (6,019) and Kk (6,509); persons who participated in the final survey
Analysis period	Initial and final surveys; additionally intermediate survey, if completed

Tab. 42: Analysis conditions and number of cases

[36] Example: 38.7% of the drop-outs report weekly driving practice over 200 km – a much higher rate than the stayers with 29.5%. Despite this remarkable difference of 9.2 percentage points, however, the overall effect of the drop-outs remains small: In the original sample, 32.6% of the respondents reported this amount of driving practice; after reduction of the sample due to drop-outs, the figure is still 29.5%. The actual impact is thus much smaller, namely 3.1 percentage points.

[37] This is a unidirectional hypothesis and is tested statistically as such.

Conclusion

The objection that persons participating in the intermediate survey report a higher rate of accidents and traffic offences simply because they recall more incidents was rejected, even though a non-significant tendency for the reporting of traffic offences was found. There is no possibility for systematic bias between the Ek and Kk groups in this respect, because practically identical proportions of both groups participated in the intermediate survey (Ek: 59.8%, Kk: 59.9%).

4.5 Systematic differences between the analysis groups

As already mentioned critically in the introduction (see also the critical remarks on methodology in GREGERSEN et al., 2000, p. 28), the participants were not assigned randomly to the analysis groups E and K, as required by experimental methodology ("randomisation"): The individual decision for a particular driving licence model at the same time determined their allocation to one or other of the two groups. As a result of this "self-selection", it can be expected that the analysis groups already differ systematically in characteristics without any causal connection with the AD17 model. It could be problematic for the analysis logic, if these characteristics were to include factors closely associated with accident risk and traffic offences.[38]

It is thus necessary to identify and measure such extraneous factors, so as to be able to take them into account appropriately in the methodology of later comparisons. The analyses should include variables such as socio-demographic background, vehicle availability and use, attitudes to vehicle availability and driving, the driving style of parents and prior experience with other vehicles.

However, the necessary comparisons between the analysis groups Ek and Kk are not only of interest for the present analyses relating to the logic of the experimental design. They also serve to characterise the individual groups. Therefore, all comparisons which also provide insights for interested readers are presented in the following results section, as they may otherwise be easily overlooked by skim readers.

A brief preview can nevertheless be given here: Section 5.4.2 compares the analysis groups according to the extent of their vehicle use. Considering the present section, it provides information on whether the groups differ systematically in other and thus possibly indirectly associated variables, apart from the evaluation criteria.

Section 5.2.2 addresses the young novice drivers' decision for a particular licence model. The delayed time of the initial survey represents a methodological problem for the interpretation of this question: The original plan was to conduct the survey immediately after the start of solo driving, but a delay of several months became necessary for technical reasons. This meant that it was no longer possible to measure an unbiased status quo at the time of the decision for or against the AD17 model, for example a person's attitude to driving at that time.[39] Factors which possibly influenced this decision could thus only be measured retrospectively.

Such retrospective data collection is hardly problematic for invariable or at least very stable factors such as gender, urban or rural place of residence, (targeted) educational attainment, prior experience with other vehicles and parents' driving style. The delay is problematic, however, with regard to a person's attitudes to the vehicle and to driving; the same applies to the factor of vehicle availability, as this may have changed with the start of solo driving. Section 5.2.2 thus performs comparisons of the aforementioned variables based on the uncertain assumption that the responses are (essentially) those which would have been given at the time of the decision for or against the AD17 model.

Conclusion

Anticipating the aforementioned sections: Apart from one statistically small difference between the compared groups, namely a tendency to higher educational attainment in the Ek group, there are

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38 For illustration, see the example in footnote 3. Another vivid example refers to vehicle availability: If it were to be found that particularly those 17-year-olds with ready access to a vehicle were more likely to choose the AD17 model, then it would not be surprising to record more accidents and traffic offences for AD17 drivers (simply because those who drive more frequently have more opportunities to be involved in accidents or commit traffic offences).

39 All variables were measured at the time of the initial survey, including the respondent's attitude to driving; this survey was completed on average more than a year after the decision for or against the AD17 model.

several very small differences, for example a tendency for greater driving practice in the Ek group. The impact of these differences is only slight, but they must nevertheless be taken into account when interpreting the results.

5 Results pertaining to the accompanied phase and the first year of solo driving

5.1 Acceptance of the model "Accompanied Driving from Age 17"

Participation

The first question to be investigated concerns the extent of acceptance of the AD17 model. To this end, data on issued driving licences were requested from the Central Register of Driving Licences (ZFER) at the Federal Motor Transport Authority (KBA) and analysed.

The development in overall participation over the five years since introduction of the AD17 model is shown for the individual federal states in Tab. 43. The reference for the proportions given in the last column of the table is the number of persons who obtained a driving licence for vehicle class B/BE up to the end of the first quarter after their 18th birthday ("early beginners"), irrespective of whether they participated in the AD17 model. The corresponding percentage of AD17 participants for Germany as a whole in 2009 was 70.5%. The so-called "city states", as well as Mecklenburg-Vorpommern and late adopter Baden-Wuerttemberg, fell considerably short of this average figure, whereas Bavaria and Lower Saxony counted an above-average proportion of AD17 participants among their early beginners.

To assess the "demand" for the AD17 model, it is necessary to consider also the development of availability from the start of the pilot scheme in Lower Saxony in April 2004 through to its adoption in the last remaining federal state (Baden-Wuerttemberg) in January 2008. Fig. 12 shows the relative development of "supply" and "demand". The availability of the model, measured as a proportion of the overall population (left-hand scale of the graph), increased in steps, with particularly sharp rises when the model was introduced in the federal states with high populations, namely in Bavaria and North Rhine-Westphalia, in Hessen and finally in Baden-Wuerttemberg. The corresponding increase in demand, however,

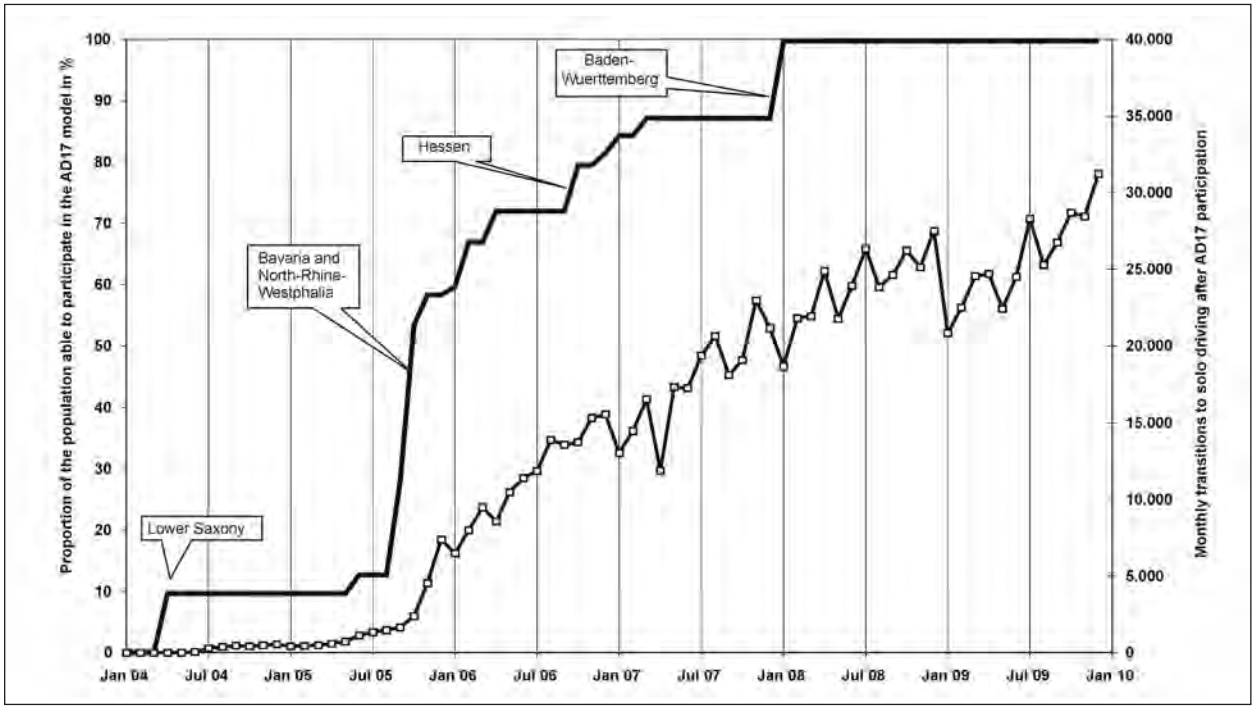

Fig. 12: Development of supply and demand: Proportion of the population able to participate in the AD17 model ("supply", thick line, left-hand scale) and number of monthly transitions to solo driving after AD17 participation ("demand", thin line, right-hand scale)

followed with a pronounced delay.[40] A steep increase in demand is apparent in the last quarter of 2005, after the awaited uniform national regulations on pilot implementation of the AD17 model came into effect in August 2005; at the same time, the large federal states Bavaria, North Rhine-Westphalia and Rhineland-Palatinate introduced the model between September and November of that year. Interpretation of the curve is not easy, however, as cyclic seasonal fluctuations overlay the long-term development: Increasing from a January low to a December high (especially pronounced in the years 2008 and 2009).

Fig. 13 presents the monthly figures for persons in Germany who received a car driving licence up to 3 months after their 18th birthday ("early beginners"). A distinction is made between former AD17 participants (solid line) and those who obtained their licence in the conventional manner (dashed line). The comparison of these two groups of early beginners shows how the AD17 model gained rapid acceptance from July 2005 and reached parity with conventional driver training within two years, namely in August 2007. There is furthermore no indication of a "saturation effect" in the continued development of the AD17 model through to the end of 2009. Over 300,000 drivers participated in the AD17 model in 2009 (Tab. 43).

Closer analysis of the 2009 figures, however, reveals a slight decline in AD17 participation in some federal states. Alongside Bremen, the states concerned are interestingly the East German states Berlin, Brandenburg, Mecklenburg-Vorpommern, Saxony, Saxony-Anhalt and Thuringia. The overall increase in AD17 participation in 2009 is attributable above all to North Rhine-Westphalia and Bavaria, and to the backlog of demand in

[40] The impression given by the graph naturally depends to some degree on the chosen scales (here specifically the right-hand scale). The scale maximum of 40,000 driving licences per month was not defined arbitrarily, however: This is the figure which could be expected if all early beginners in Germany were to choose the AD17 model.

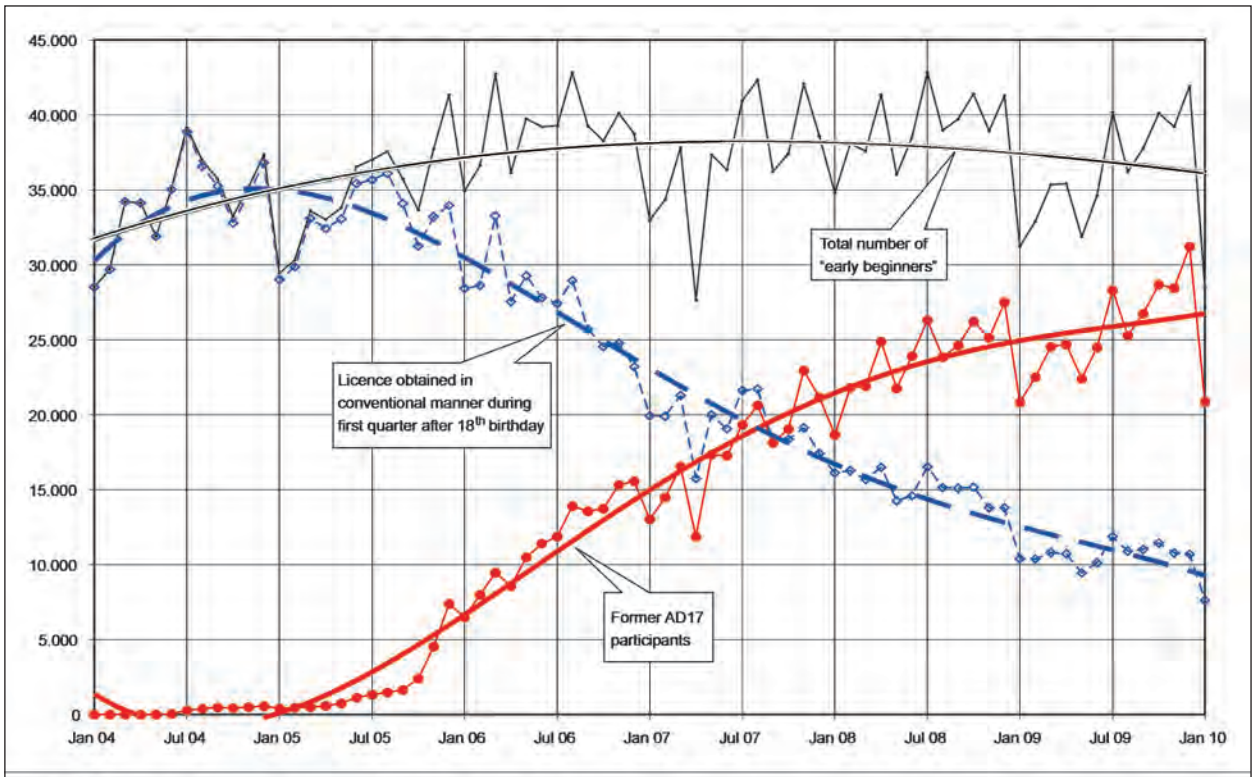

Fig. 13: Monthly figures (nationwide) of persons receiving a full driving licence for vehicle class B/BE during the first quarter after their 18th birthday ("early beginners"), separately for former participants in the AD17 model and persons who obtained their licence in the conventional manner

Federal state	Start of model	Year						Total	Percentage of early beginners 2009*
		2004	2005	2006	2007	2008	2009		
Schleswig-Holstein	01.10.2005	*4*	240	5,573	7,504	9,629	10,045	32,995	69.3%
Hamburg	01.06.2005	*2*	251	1,129	1,711	2,222	2,348	7,663	65.5%
Lower Saxony	01.04.2004	2,709	12,940	22,432	29,009	33,972	36,631	137,693	75.0%
Bremen	01.06.2005	-	159	667	946	1,118	1,091	3,981	63.4%
North Rhine-Westphalia	28.09.2005	*62*	1,576	34,896	41,455	53,132	63,976	195,097	70.5%
Hessen	01.10.2006	*8*	*9*	830	17,033	20,872	22,346	61,098	68.1%
Rhineland-Palatinate	01.11.2005	*2*	539	12,226	15,859	18,702	18,907	66,235	74.1%
Baden-Wuerttemberg	01.01.2008	*1*	*3*	*2*	*18*	34,569	43,885	78,478	61.2%
Bavaria	01.09.2005	*1,471*	8,329	45,146	57,022	69,970	74,654	256,592	77.7%
Saarland	01.01.2006	*6*	*15*	2,246	3,283	4,068	4,259	13,879	73.6%
Berlin	01.02.2006	-	-	2,056	3,106	2,914	2,772	10,848	61.3%
Brandenburg	01.02.2006	*1*	-	5,040	7,566	7,083	5,188	24,878	67.0%
Mecklenburg-Vorpommern	25.11.2006	*2*	*6*	9	3,909	3,997	2,891	10,814	60.6%
Saxony	15.03.2006	*1*	*4*	6,423	11,888	11,481	9,010	38,807	68.2%
Saxony-Anhalt	01.01.2007	-	-	*1*	5,998	6,262	4,919	17,180	66.1%
Thuringia	01.03.2007	*1*	*2*	*5*	5,576	6,871	5,246	17,701	67.2%
Germany		**4,272**	**24,073**	**138,681**	**211,883**	**286,862**	**308,168**	**973,939**	**70.5%**

The figures in italics represent persons who were registered as AD17 participants by the licensing authorities despite the fact that their federal state had not yet introduced the AD17 model in the year concerned (with the exception of Bavaria in 2004, the numbers are negligible);

* = AD17 participants as a proportion of all "early beginners" in 2009, i.e. persons who obtained a driving licence for vehicle class B/BE up to the end of the first quarter after their 18th birthday, irrespective of participation in the AD17 model.

Tab. 43: Scope of participation in the AD17 model in the years 2004 to 2009 by federal state

Baden-Wuerttemberg, which had only joined the model in the previous year.

Parallel to the increase in AD17 participation, the attractiveness of the conventional driver training model continues to decline in the eyes of early beginners. According to the latest available figures (4th quarter of 2009), over 72% of the early beginners in Germany, i.e. those persons obtaining a driving licence up to the end of the first quarter after their 18th birthday, choose the AD17 model.

This figure compares well to that determined by GREGERSEN et al. (2000) in their evaluation of the Swedish model: In Sweden, around 45 to 50% of the relevant group opted for the new model. If the participation rate of the present study, namely 72% of the early beginners, is adjusted to refer to all 18-year-olds (where the proportion of early beginners is almost 70%; see Fig. 14), the corresponding result is around 50%.

The proportion of AD17 participants among the novice drivers obtaining a licence for vehicle class B/BE in 2009 can be calculated as follows: According to official statistics (Kraftfahrt-Bundesamt, 2010, Tab. FE-FaP 2), a total of 814,000 persons received a probationary driving licence for vehicle class B/BE, i.e. as novice drivers. The 308,000 AD17 drivers indicated in Tab. 43 represent a proportion of 37.8%. It can thus be said that already more than one-third of all novice car drivers in Germany had participated in the AD17 model in 2009.

Is there evidence of increased demand for driving licences for vehicle class B/BE in the age group relevant for the evaluation?

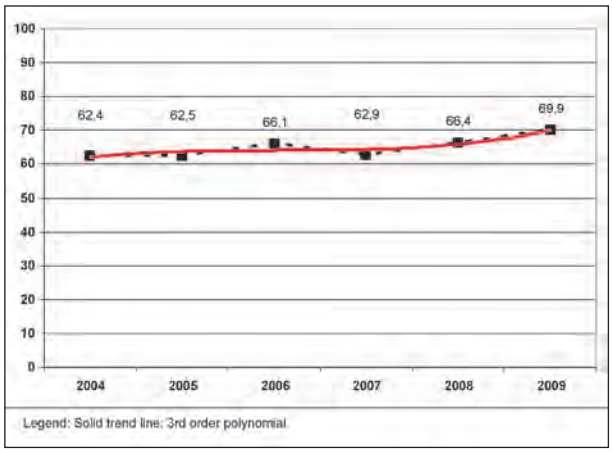

Fig. 14: Early beginners as a percentage of all persons obtaining a driving licence for vehicle class B/BE before their 19th birthday

In Section 1.2, the hypothesis is formulated that the new AD17 driving licence model stimulates increased demand particularly among young prospective drivers ("Hypothetical effect 1"). Such an effect would expand the at-risk population and consequently lead to more accidents involving 18-year-old drivers.

To test this hypothesis, the development in the total number of early beginners was analysed for the period after the sharp rise in AD17 participation in July 2005 (upper grey line in Fig. 13). The smoothed curve indicates a significant increase in the first half of 2004, i.e. before the introduction of the model in most federal states, but already stabilises at the beginning of 2006; the curve subsequently remains relatively constant at an average level of around 38,000 driving licences per month (with a few fluctuations) until the end of 2008, despite the continued increase in AD17 figures. The most pronounced increase in the overall demand for "early" driving licences thus occurs before the introduction of the AD17 model and must therefore be attributable to other factors. During the period of strongest growth in AD17 participation, namely between mid-2005 and the end of 2008, the increase in demand for driving licences from early beginners was approx. three per cent according to the moving average in Fig. 13 (upper grey line).

Is it possible, however, to exclude the possibility that there was no increased interest in a specifically "early" commencement of driving in these years, but rather a greater general interest in obtaining a driving licence at the age of 18 that is independent of considerations relating to the AD17 model? If this were the case, the figures for all other 18-year-old novice drivers, i.e. those receiving a driving licence in the second, third and fourth quarters after their 18th birthday, should have increased in the same manner as for early beginners.

This hypothesis can be tested. To this end, all driving licences issued to persons under 19 years for vehicle class B/BE were counted on the basis of data from the Central Register of Driving Licences (ZFER) for the years 2004 to 2009. The already determined numbers of early beginners (upper grey line in Fig. 13) were related to these new figures. The results are presented in Fig. 14. The trend line shows a slight increase: Whereas 62 to 63% of the novice drivers under 19 years of age initially chose an "early start" (irrespective of whether by the AD17 or conventional model), their proportion was closer to 70% in 2009. This is indication of a tendency to bring forward the start of driving. The effect, however, is weak and not particularly convincing.[41]

Demographic changes must be taken into account when exploring potential causes for the observed changes in the numbers of driving licence applications. In the following, therefore, the number of driving licences issued for vehicle class B/BE is analysed per 10,000 persons of the same age group. A basis for this analysis is provided by corresponding official figures, namely driving licences issued (ZFER, KBA) and overall population (DESTATIS). In contrast to Fig. 13 (for reasons of data availability), Fig. 15 and Fig. 16 refer to the whole population of 17 and 18-year-olds, rather than just to early beginners (though the latter do account for around two-thirds of this age group, as shown in Fig. 14).

Fig. 15 presents the development since 2004 for young men, Fig. 16 the development for young women. In both cases, the number of licences issued to 18-year-olds increases at approximately the same rate as the number of licences issued to 17-year-olds decreases. The AD17 model is thus gradually superseding the conventional form of driver training.

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41 Data for 1987 and 1989 already permitted HANSJOSTEN & SCHADE (1997, p. 13) to report that "two-thirds of those aged 18 at the time of issuing … obtained their driving licence within three months after their birthday."

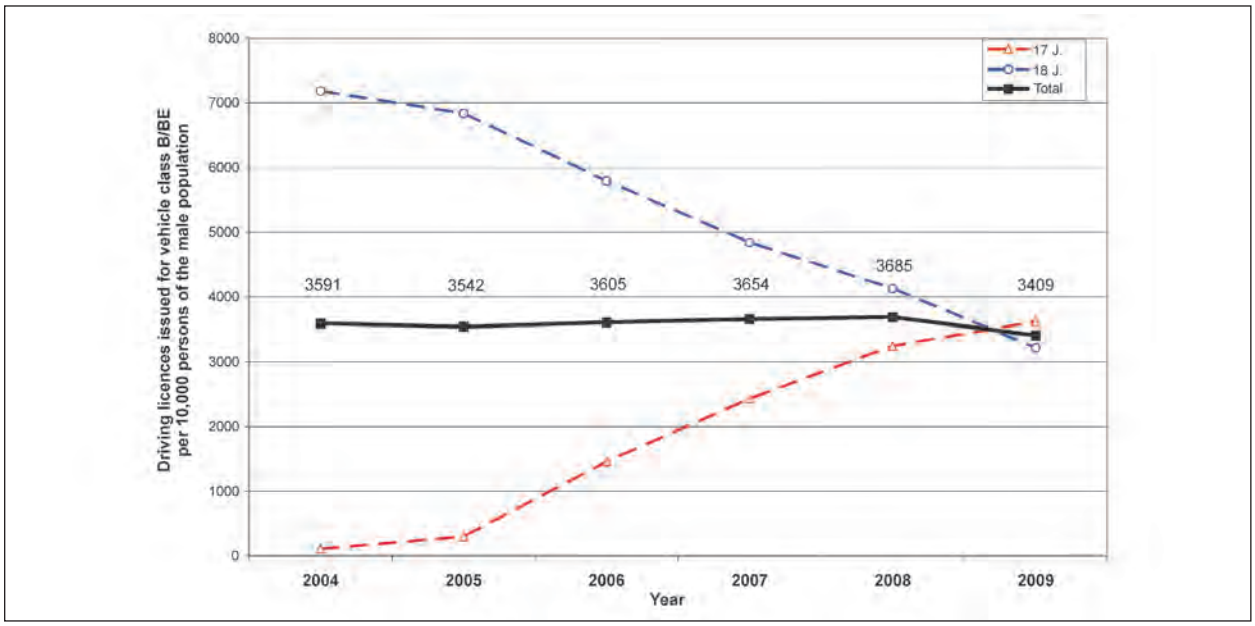

Fig. 15: Driving licences for vehicle class B/BE issued to young men aged 17 and 18 years per 10,000 persons of the respective population

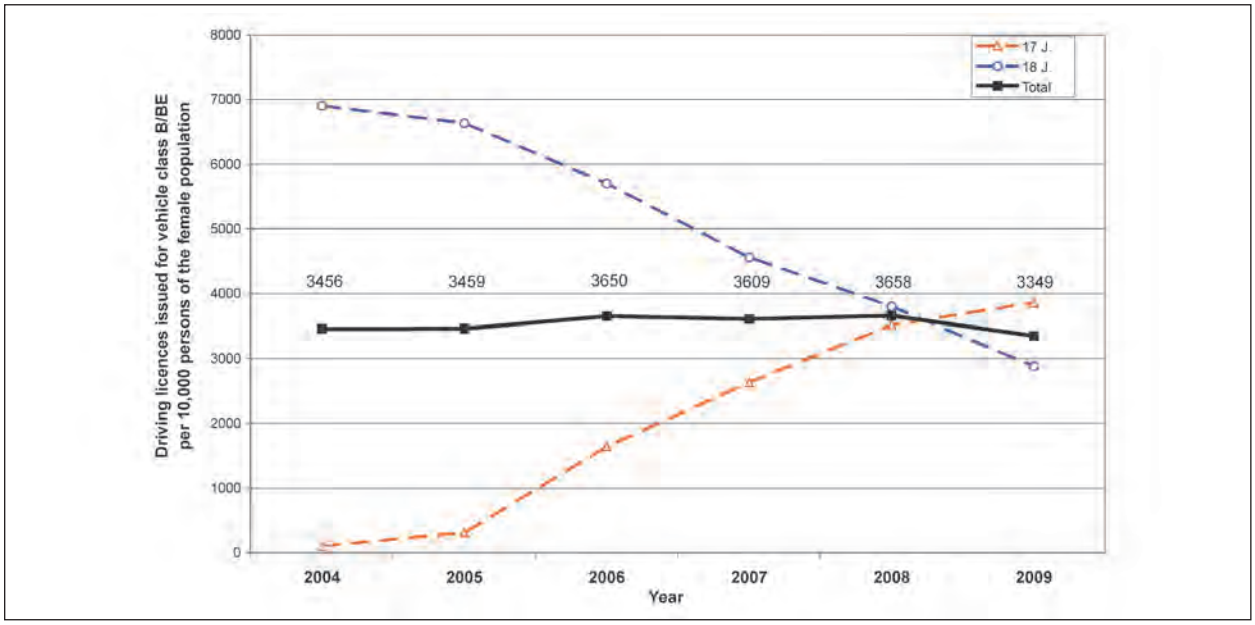

Fig. 16: Driving licences for vehicle class B/BE issued to young women aged 17 and 18 years per 10,000 persons of the respective population

To test the hypothesis that the AD17 model stimulates increased demand, the figure of interest is the total number of driving licences issued to 17 or 18-year-olds (solid lines in Fig. 15 and Fig. 16). In the years with the greatest rise in AD17 participation, namely between 2005 and 2008, the total number of licences issued to male 17 and 18-year-olds increased by +1.8% (2006), +1.4% (2007) and +0.8% (2008), in other words by 4.0% over the three years; the corresponding figures for female 17 and 18-year-olds were +5.5%, -1.1% and +1.4%, i.e. a total increase of 5.8%. In 2009, however, the figures fell sharply by -7.5% for young men and by -8.4% for young women; this more than outweighed the increases of the previous three years (2009 compared to 2005: -3.8% for young men and -3.2% for young women). This drop in 2009 is also reflected in the number of early beginners (upper grey line in Fig. 13).

The pronounced drop in the number of licences issued in 2009 is all the more

remarkable[42] when compared to the corresponding figures for the remaining population, namely men and women aged[43] 19 years or more, where there was no pronounced decrease. It is thus difficult to demonstrate the otherwise likely correlation with the height of the economic recession in 2009.

The superimposition of various social processes makes unambiguous attribution of individual effects difficult. The increase in driving licence demand per 1,000 persons under 19 years of age during the three-year phase of introduction of the AD17 model from 2005 to 2008 (four per cent for young men and six per cent for young women, i.e. approx. five per cent in total) can thus only be quantified with a degree of uncertainty. The data available at the time of writing do not permit firm conclusions on whether this is a lasting increase or merely the reflection of a short-term "sensation effect" accompanying the introduction of the AD17 model. The decrease in 2009 seems indicative of a temporary effect. The specified five per cent increase in demand should thus be viewed as an estimated maximum for the time being.

Conclusion

In 2008 and 2009, the first years in which all federal states had introduced the pilot scheme, around 300,000 young drivers participated in the AD17 model each year. That represents more than one-third of all novice drivers receiving a probationary driving licence for vehicle class B/BE in Germany. Towards the end of 2009, almost three-quarters of all early beginners opted for the AD17 model. By the end of 2009, almost one million young drivers had participated successfully in the AD17 model since its introduction in Germany. This figure is expected to have reached approx. 1.27 million by the end of the period of pilot implementation on 31.12.2010.

Despite the impressive success, the increase in demand for driving licences by early beginners increased by only five per cent relative to the overall population during the phase of introduction from 2005 to 2008. In other words: 95 per cent of the AD17 participants would have obtained a driving licence during the first three months after their 18th birthday even without the possibilities offered by the AD17 model.

Although small effect was found in relation to the initially formulated "Hypothetical effect 1" (Section 1.2) of increased "early exposure" to road traffic for the phase of introduction of the AD17 model. But there are clear indications, that the increase in demand is only a temporary effect.

5.2 Who chooses accompanied driving from age 17?

The AD17 model is a voluntary scheme. It can thus be assumed that it attracts only those persons who not only meet the specified requirements, but also display further favourable traits and expect greater benefits from participation; therefore, a "self-selection effect", as known in sociology, is to be expected. This would mean that the analysis groups Ek and Kk differ systematically in certain aspects related to the self-selection effect. Their fundamental affinity to driving, however, is hardly likely to differ, as both belong to the special group of early beginners.

Proof of a self-selection effect would be extremely significant for the evaluation project[43], because it impairs the comparability of the analysis samples. This can be illustrated with an example: If it is assumed that predominantly male drivers choose the AD17 model, then a comparison of the E and K samples would at the same time become a comparison of male and female drivers. However, as male drivers are on average more frequently involved in traffic offences/accidents compared to female drivers, the relative result for the E group would be poor. If the self-recruitment effect is not recognised and taken into account, this could therefore lead to unjustified devaluation of the AD17 model.

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42 The decline could be viewed as a sign of normalisation, namely that ever wider presentation as a normal procedure in the media had reduced the "sensation value" of the AD17 model.

43 Alongside this methodological relevance, a self-recruitment effect is also important in the political context: In press commentaries in advance of introduction of the AD17 model, critics expressed the concern that (summarising the gist of their presumption) only "offspring of the already privileged classes" would be able to make use of the new opportunities. Even if this would not detract from the expected road safety gains, it could possibly damage the image of the model.

5.2.1 Reasons for not participating in the AD17 model

The first analysis addresses the reasons given by survey respondents for their decision not to participate in the AD17 model (the analysed cases are shown in Tab. 44).

As part of the initial survey, all persons in the Kk group, i.e. the contacted 18-year-olds who obtained their driving licence in the conventional manner, were asked to specify their reasons for not participating in the AD17 model. Tab. 45 presents the responses from all online and paper questionnaires, separated for male and female respondents.

More than two reasons for not participating were given by 27.8% of the female respondents, compared to only 23.7% of the male respondents. This difference is significant (chi-square = 23.07, df = 1, $p < 0.001$). The rates of mention are thus higher for female respondents in practically all the categories shown in Tab. 45, with one remarkable exception: Fewer female respondents indicated that they had been unaware of the possibility of accompanied driving (3.5% compared to 5.6% of the male respondents). Otherwise, the distribution of the responses is very similar; male and female respondents gave essentially the same reasons. A lack of information about the model was mentioned by 4.5% of the survey respondents overall.

It can be seen that other personal priorities dominate the list of reasons given (no interest 69%, wrong moment or no opportunity 35%), followed by lacking requirements (37%; including specifically: No money 25%, no vehicle 13%, no parental consent 4%). The lack of a suitable accompanying passenger (14%) also belongs in this category. In this context, some respondents specified that a possible accompanying passenger was “rejected for personal reasons” (8%), while others had no such person in their personal surroundings (2%). In a few cases, no accompanying passenger was found because formal conditions could not be met (6.2%; including specifically: Too young 4.2%, own period of licence possession too short 3.7%, too many penalty points 1.4%).

Conclusion

If personal reasons (other priorities) and lack of information are excluded, the only remaining “external reasons” are the various lacking

Sample size	N = 10,825
Data source	Online questionnaire (9,977), Paper questionnaire (848)
Analysis group	Kk (10,825)
Analysis period	Initial survey

Tab. 44: Analysis conditions and number of cases

Reasons for not participating in the AD17 model	m in %	f in %	Total in %
I was not yet aware of the possibility of accompanied driving from 17 at the time.	5.6	3.5	4.5
I did not want to apply for a driving licence at the time; it did not fit into my plans.	32.4	36.7	34.7
It was not interesting for me; there were no benefits to be gained.	68.9	69.6	69.3
My parents refused to give their consent.	3.2	4.3	3.8
I was unable to apply for a driving licence at the time, because:	34.3	39.7	37.2
… I did not yet have the necessary money.	23.6	25.4	24.6
… no vehicle was available.	12.5	12.4	12.5
… I could not find an accompanying passenger in my personal surroundings, because:	11.4	16.6	14.2
… there was no such person in my personal surroundings.	1.9	2.9	2.4
… I rejected the possible accompanying passengers for personal reasons.	7.1	9.2	8.2
… the formal conditions were not met:	4.5	7.7	6.2
… Possible accompanying passengers had not held a driving licence for a sufficient period.	2.5	4.8	3.7
… Possible accompanying passengers were not yet 30 years of age.	2.9	5.2	4.2
… Possible accompanying passengers had too many penalty points in the Flensburg register.	1.1	1.7	1.4
Other reasons	23.7	22.7	23.2
m = male, f = female Total number of persons (Kk group): 10,777 Number of reasons mentioned: 20,740			

Tab. 45: Responses given by persons with a licence obtained in the conventional manner in response to the question: “Why did you not participate in the AD17 model?” (Percentages of persons mentioning the reason)

prerequisites mentioned by 37% of the respondents. In two-thirds of these cases, the necessary money was lacking[44]; to a large extent that overlapped the one-third of cases in which no vehicle was available, and a further one-third did not have a suitable accompanying passenger. Where no accompaniment was found, this was due to legal prerequisites in only 44% of the cases. The present legal barriers for the accompanying passenger do not appear to hinder participation particularly; only 6.2% of all respondents specified this reason. Among the external factors, it is thus above all financial reasons and the lack of a vehicle which act restrictively (mentioned by 12.5% of all respondents).

5.2.2 Determinant factors for the decision to engage in accompanied driving

Critical attention has been drawn to the possibility that the voluntary nature of the AD17 model entails a "self-selection effect": The assignment of survey respondents on the basis of driving licence model (AD17 versus conventional) is not truly random, but rather predetermined to a certain extent by factors such as socio-demographic background, prior experience with other vehicles, attitudes to vehicle availability and driving, and the availability of a suitable vehicle in the household.

The following analysis thus tests the hypothesis that these factors co-determine the choice of driving licence model. To this end, separate logistic regressions with the factors gender, educational attainment and place of residence (urban/rural) as independent variables were calculated for each factor included in the initial questionnaire[45]. In other words, the choice of driving licence model was predicted on the basis of the factor concerned, whilst controlling for gender, educational attainment and place of residence. In this way, any contribution over and above the known influences of gender, educational attainment and place of residence on the model decision can be identified.

Sample size	N = 20,346
Data source	Online questionnaire (18,762), Paper questionnaire (1,584)
Analysis groups	Ek (9,521) and Kk (10,825)
Analysis period	Initial survey

Tab. 46: Analysis conditions and number of cases

All calculated regression coefficients which indicated a main effect for the factor concerned or an interaction of this factor with the control variables were tested for statistical significance. Given the multitude of tests (120) and the associated inflation of the applied maximum alpha error of one per cent, testing was carried out nominally at a 0.1 per cent level. For significant regression coefficients, the odds difference was calculated (see Formulas 4 and 5 in Section 2.2.2); this specifies the relative "chance" that a person will choose the AD17 driving licence model.

Tab. 46 provides an overview of the cases relevant for the analysis in this section. The numbers of cases considered in the individual logistic regression calculations are shown in Tab. 35, column N.

As a first step, the possible influence of the control variables on the choice of driving licence model was investigated. Logistic regression was used to predict the driving licence model on the basis of the factors gender, educational attainment and place of residence (urban/rural). The results are presented in Tab. 47.

Two effects are significant: Higher (actual or at least targeted) educational attainment increases the "chance" that a person will choose the AD17 model rather than conventional driver training by over 20%; this chance is also almost 7% higher for residents of rural areas than for town-dwellers.

In the following, it can now be considered whether the remaining factors influence choice after the known influences of educational attainment and place of residence have been taken into account.

There are indeed a number of significant effects (Tab. 48): Factors which act in favour of the AD17 model after adjustment for the influences of gender,

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44 Money was apparently only lacking at the age of 17 years; after all, the persons in this group had sufficient money to obtain a driving licence at 18 years of age. Casual employment may have played a role here.

45 Ideally, this test should only consider factors in the form in which they were manifested at the time of the licence model decision. The available data, however, do not precede the time of initial survey, i.e. several months after the start of solo driving. This delay is hardly problematic for factors such as gender, place of residence or targeted educational attainment, as such factors are sufficiently constant. The situation is more problematic for factors which may have changed through the experience of accompanied driving, for example the appreciation of vehicle availability. This aspect must be taken into account when interpreting the results.

Tested influence (independent variables) (N = 20,320)	Regression coefficient	"Chance**" for AD17
Gender: Female (versus male)	+0.030 n.s.	-
Educational attainment: Advanced school certificate (versus lower)	+0.188 sign.	+20.7%
Place of residence: Rural (versus urban)	+0.069 sign.	+ 6.7%
2-way interactions	n.s.	-
3-way interactions	n.s.	-
* = see footnote 33; ** = relative odds difference sign. = significant at 1 per cent level; n.s. = not significant Interpretation example: Persons with higher educational attainment are 20.7% more likely to choose the AD17 model than persons with lower educational attainment.		

Tab. 47: Influence of the variables gender, educational attainment and place of residence (urban/rural) on the choice of driving licence model (predictions based on logistic regression)

educational attainment and place of residence are (in order of the extent of this effect):

- The availability of further vehicles in the household,
- particular appreciation of a vehicle as a source of mobility, and
- a positive parental role model, i.e. conscientious compliance with traffic rules.

Parental compliance with traffic rules does not necessarily influence the licence model decision in only the psychological sense; there may also be a pragmatic component: Parents are by far the most frequent accompanying passengers for AD17 participants (as will be shown later in Tab. 54); if they carry too many penalty points and are thus not eligible for the role of accompanying passenger, there is often no alternative to the conventional licence model. As such cases occur only rarely, however, this scenario cannot solely explain the findings, as can be seen from Tab. 45.

By contrast, the following factors act against choice of the AD17 model:

- Reliance on a vehicle in a poor technical condition, and
- road practice with other vehicles.

In the latter case, it can be assumed that the previous practice itself is not the decisive aspect; it

Tested influence (independent variables)	Regression coefficient	"Chance*" for AD17
Previous practice with other vehicles (more than 10 km)	-0.142 sign.	-13.3%
Appreciation of the vehicle: Mobility (affirmed)	+0.106 sign.	+11.2%
Appreciation of the vehicle: Fun (affirmed)	+0.004 n.s.	
Reason for vehicle purchase decision: Performance (affirmed)	+0.043 n.s.	
Reason for vehicle purchase decision: Consumption (affirmed)	-0.033 n.s.	
Reason for vehicle purchase decision: Utility value (affirmed)	+0.003 n.s.	
Reason for vehicle purchase decision: Safety (affirmed)	+0.045 n.s.	
Father's compliance with traffic rules (affirmed)	+0.087 sign.	+9.1%
Mother's compliance with traffic rules (affirmed)	+0.120 sign.	+12.8%
Father's driving style described as sporty (affirmed)	-0.012 n.s.	
Mother's driving style described as sporty (affirmed)	+0.000 n.s.	
Educational attainment of parents (advanced school certificate or higher)	+0.033 n.s.	
Technical condition of the primarily used vehicle (with defects) [46]	-0.190 sign.	-17.3%
Further vehicles in the household (yes) [46]	+0.138 sign.	+14.8%
sign. = significant at 1 per cent level; n.s. = not significant; * = relative odds difference Interpretation example: Persons with more than 10 km previous practice with other vehicles are 13.3% more likely to choose the AD17 model than persons without such previous practice.		

Tab. 48: Factors influencing the choice of driving licence model beyond the joint influence of the variables gender, educational attainment and place of residence (predictions based on logistic regression)

is more probable that the associated availability of other means of transport, for example a moped, reduces the necessity to apply for a car driving licence.

[46] These data were not collected until after the start of solo driving, in other words after the end of the accompanied driving phase in the case of AD17 participants. It is conceivable that vehicle availability during the accompanied driving phase differed from that specified here in some cases (see also footnote 45).

Sample size	N = 8,472
Data source	Online questionnaire (8,472)
Analysis groups	Ek (4,440) and Kk (4,032)
Analysis period	Intermediate survey

Tab. 49: Analysis conditions and number of cases for the additional analysis

It is occasionally proposed that higher educational attainment of the parents makes the family more receptive for the safety-oriented arguments of the AD17 model; this assumption is not supported: The educational attainment of parents is only significant for the choice of driving licence model when the educational attainment of the licence applicant is not considered. In other words: Once the school certificate obtained or targeted by the novice driver is taken into account, the educational attainment of parents plays no role in the decision.

A separate additional analysis addresses the question of whether distinctive personality traits of the novice driver may have influenced the decision for a particular licence model. Regarding the individual traits and the method of acquisition, see Section 2.1.2. Tab. 49 provides an overview of the cases relevant for this additional analysis. As the personality traits could only be gathered as part of the intermediate survey, the data refer only to a subset of the overall sample, namely those persons who completed both the initial and intermediate surveys. For the analysis, data from the initial and intermediate surveys had to be combined accordingly.

To test the influence on the licence model decision, a logistic regression model was calculated for the six personality traits with the control factors gender, educational attainment and place of residence (urban/rural) as independent variables. In other words, the choice of driving licence model was predicted on the basis of personality traits, whilst controlling for gender, educational attainment and place of residence. In contrast to the previous analysis, all the independent variables were entered simultaneously into the regression model. In this way, any contribution over and above the known influences of gender, educational attainment and place of residence can be identified. This regression model considers only main effects. For significant regression coefficients, the odds difference was calculated (see Formula 5 in Section 2.2.2); this specifies the relative "chance" that a person will choose the AD17 driving licence model.

Tested influence (independent variables) Personality traits [47]	Regression coefficient	"Chance* " for AD17
Extraversion (above average)	+0.079 n.s.	–
Agreeableness (above average)	+0.085 n.s.	–
Conscientiousness (above average)	+0.094 n.s.	–
Neuroticism (above average)	-0.010 n.s.	–
Openness (above average)	-0.051 n.s.	–
Risk-taking propensity (above average)	-0.081 n.s.	–

sign. = significant at 1 per cent level;
n.s. = not significant; * = relative odds difference;
Interpretation example: Persons who display above-average extraversion are not more likely to choose the AD17 model than others.

Tab. 50: Influence of personality traits on the choice of driving licence model, beyond the joint influence of the variables gender, educational attainment and place of residence (predictions based on logistic regression)

The results of the logistic regression are shown in the following table (Tab. 50). None of the six main effects tested reached the defined significance threshold of a one per cent probability of error. There is thus no evidence to suggest that personality traits influence the decision for a particular driving licence model.

Conclusion

The aforementioned influences on the licence model decision, in particular educational attainment, rural place of residence and the availability of further vehicles in the household, are significant; the effect sizes, however, are small (educational attainment) or even very small according to statistical convention[48]. This means that the choice of driving licence model is in no way determined by these factors, and is essentially dependent on other circumstances (see the reasons specified in Tab. 45). Personality traits appear to play no role in decision-making.

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47 The data on personality traits were not collected until long after the decision for a particular driving licence model, namely in the intermediate survey (regarding the problems of this method, see footnote 45).

48 see, for example, the classification by COHEN (1970)

5.3 The accompanied driving phase

The initial survey concerned itself retrospectively with (among other things) the respondent's accompanied driving phase, i.e. the period during which participants in the AD17 model were (only) permitted to drive with qualified accompaniment. The outcome evaluation seeks to identify those factors contained in the gathered information which contribute to the success or failure of the AD17 model. This, for example, includes the questions of whether and to what extent the additional practice during the accompanied phase contributes to safer driving after the transition to solo driving.

This section serves firstly to merely describe the findings derived from the survey results and the retrieval of VZR data records with regard to the accompanied driving phase.

Duration of the accompanied driving phase

For the recruitment of participants, data from the ZFER on all persons who had completed their participation in the AD17 model during the "recruitment period" from 16.03. to 31.08.2007 were used (Section 2.3.1). At this point, the model had been running for at least 12 months in all eleven participating federal states.

For these 72,256 former AD17 participants, the duration of the accompanied driving phase was calculated as the time between the start of participation and the person's 18th birthday (Fig. 17).

As was to be expected (manifesting the great interest present in this age group), many young people joined the AD17 model immediately after their 17th birthday. Subsequently, the number of new AD17 participants fell abruptly to less than half within just one week, before gradually increasing to a weekly rate which remained constant over a period of several months.

The "dip" between weeks 3 and around 15 (see Fig. 17) is more than compensated by the "surplus" during the first two weeks. This suggests that a number of persons who would otherwise have joined the AD17 model evenly distributed over the first weeks simply brought this decision forward by a few weeks in order to make maximum use of the available period. This "opportunism effect" evaporated after around three months, and was furthermore not particularly great in the first place: The initial "surplus" represented only around 11% of the total number of participants up to week 15. Thereafter, the figures remained practically constant for almost six months.

It is interesting to note that interest in the AD17 model only began to decline only after around eight months, i.e. four months before a person's 18th birthday; this decline was furthermore very gradual. There were still many participants joining the AD17 model in the final eight weeks before their 18th birthday: The interest was here only one-third less than in the previous months. It is difficult to understand, however, why so many persons still joined the AD17 model during the last two weeks before their 18th birthday.

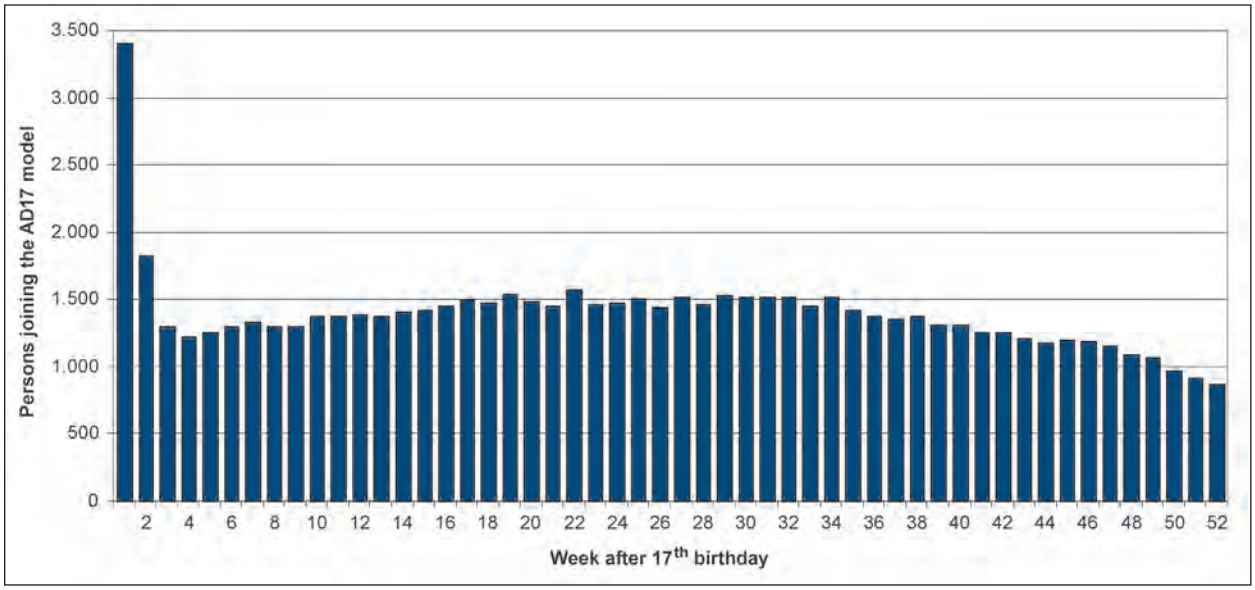

Fig. 17: Persons joining the AD17 model in the 11 participating federal states per week after their 17th birthday

	Duration of accompanied driving phase (N = 72,256)	
	in weeks	in months
Mean	28.6	6.6
Standard deviation	14.7	3.4
Median	28.7	6.6
90th percentile	49.3	11.4
Minimum	1.0	0.2
Maximum	52.0	12.0

Tab. 51: Duration of the accompanied driving phase

Sample size	N = 9,521
Data source	Online questionnaire (8,785), Paper questionnaire (736)
Analysis group	Ek (9,521)
Analysis period	Initial survey

Tab. 52: Analysis conditions and number of cases

Duration of accompanied driving phase in the Ek group (N = 9,521) (in weeks)			
	Male	Female	Total
Mean	34.2	33.6	33.9
Standard deviation	12.2	12.0	12.1
Median	34.6	33.9	34.1
90th percentile	51.0	50.7	50.9
Minimum	1.0	1.0	1.0
Maximum	52.0	52.0	52.0

Tab. 53: Duration of the accompanied driving phase in the Ek survey sample in weeks

It is very important for the evaluation of the AD17 model to recognise that a considerable proportion of the young drivers (44.5%) participated in accompanied driving for less than half of the maximum possible period, namely for less than six full months (even if this shortening of the practice period was not the result of a conscious decision).[49] The average duration of the accompanied driving phase was almost 29 weeks or 6.6 months (Tab. 51).

It is at this point expedient to repeat the remarks made in Section 2.1.1, namely that the further analyses, and in particular the outcome evaluation, consider only those persons who participated in the AD17 model for at least three months. This is because an excessively short accompanied driving phase does not reflect the intention of the model and can thus hardly trigger the intended positive effects.

Tab. 52 provides an overview of the cases taken into account in the further analyses in this section.

Fig. 18 and Tab. 53 show the correspondingly adjusted durations of the accompanied driving phase for the survey participants in the Ek group.

It is apparent that the demand of a minimum accompanied phase of three months was not met in all cases. As the number of such cases was only

[49] The reasons are explained in the formative evaluation conducted by IfeS (FUNK & GRÜNINGER, 2008, Tab. 6-4).

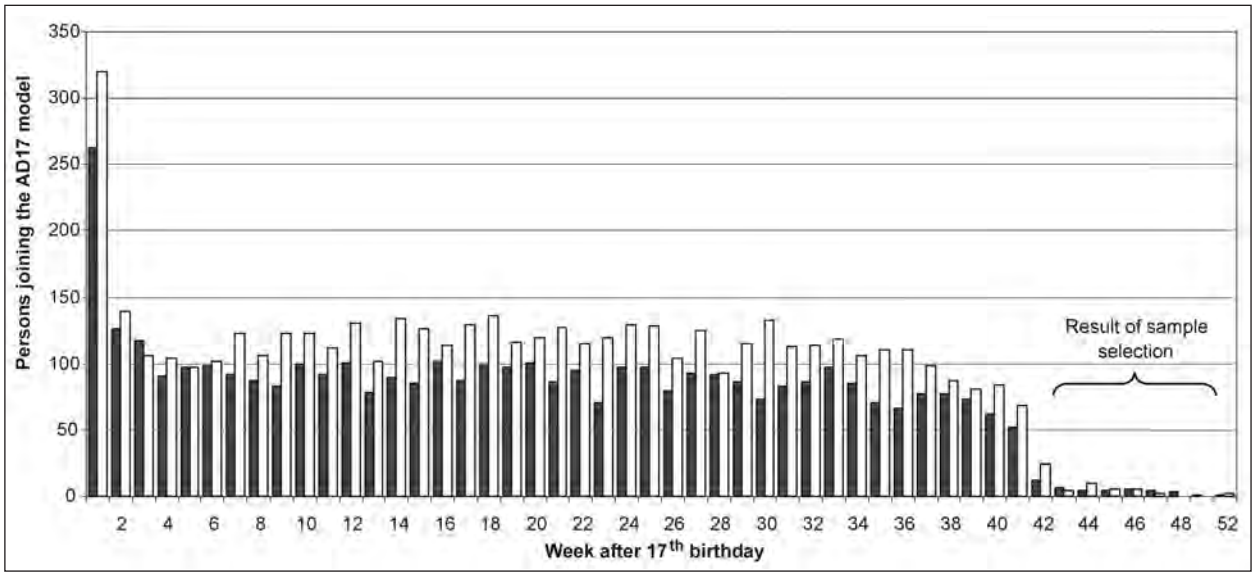

Fig. 18: Start of AD17 participation in weeks after the person's 17th birthday, separately for the male (grey bars) and female participants (white bars) in the Ek sample

small (less than 3%), however, it was considered unnecessary to exclude these cases from the further analyses and outcome evaluation. The table also shows that the duration of the accompanied driving phase differed by less than a week between male and female participants; this is unlikely to affect interpretation of the results.

In the further presentations of results, the male (N = 4,214) and female (N = 5,307) AD17 participants are considered separately (total 9,521 participants). Because of the large sample sizes, even a few percentage points of difference are already statistically significant. Differences emphasised in the text are thus generally statistically significant, even where this is not mentioned expressly.

Two qualifying remarks are necessary with regard to the interpretation of results in the present section: Firstly, the initial survey was not conducted until on average seven months after the phase of accompanied driving; this could facilitate memory effects (see Tab. 18). Secondly, the analyses consider almost exclusively persons who participated in the AD17 model for at least three months. It is the task of the formative evaluation (FUNK & GRÜNINGER, 2010), not of the summative evaluation, to provide an in-depth and immediate investigation of the accompanied driving phase without limitation to certain groups. Therefore, and despite the large underlying samples, the results presented here on the accompanied driving phase should be deemed predominantly supplementary in character.

Accompanying passenger

The most frequently nominated accompanying passenger was one of the novice driver's parents (Tab. 54). Both male and female participants chose a parent in 97.1% of cases. While female participants displayed a very pronounced preference[50] for their mother as accompanying passenger (66.3% compared to only 29.4% for their fathers), this effect was somewhat less prominent among male participants (50.6% preference for mothers compared to 44.9% for fathers). Generally, male participants chose a male accompanying passenger much more frequently than female participants (46.7% compared to 30.8%). Even so, a female accompanying passenger was preferred by both gender groups.

The fact that another relative was chosen as accompanying passenger in only 1.9% of cases, and a non-relative in even only 0.6% of cases, is indicative of the great importance of parental support for the AD17 model.

Around 91% of the accompanying passengers were aged between 40 and 59 years at the end of the accompanied driving phase (Tab. 55). This applies to both male and female participants and follows

Who was your most frequent accompanying passenger during the phase of accompanied driving?			
Degree of relationship	**Male in %**	**Female in %**	**Total in %**
Father/male guardian	44.9	29.4	36.2
Mother/female guardian	50.6	66.3	59.4
Parent (not specified)	1.6	1.4	1.5
Grandfather	0.9	0.7	0.8
Grandmother	0.3	0.8	0.6
Other male relative	0.4	0.3	0.3
Other female relative	0.2	0.2	0.2
Male work colleague	0.1	0.0	0.0
Female work colleague	0.0	0.0	0.0
Other male person	0.4	0.4	0.4
Other female person	0.2	0.2	0.2
No data provided	0.4	0.3	0.4
Total	100	100	100

Tab. 54: Choice of accompanying passenger differentiated by driver gender

How old was your most frequent accompanying passenger during the phase of accompanied driving?			
Age	**Male in %**	**Female in %**	**Total in %**
Between 30 and 39 years	5.7	6.5	6.1
Between 40 and 49 years	68.2	70.7	69.6
Between 50 and 59 years	23.2	20.3	21.6
Between 60 and 69 years	1.7	1.4	1.6
70 years and older	0.7	0.7	0.7
No data provided	0.4	0.4	0.4
Total	100	100	100

Tab. 55: Age of accompanying passenger differentiated by driver gender

[50] The choice must not necessarily be a reflection of preference; it could also be connected with their mothers' greater time planning flexibility.

almost automatically from being parent of an 18-year-old novice driver.

Further details on accompanying passengers are given in the process evaluation report on the AD17 model (FUNK & GRÜNINGER, 2010, Tab. 4-20).

Vehicle availability during the accompanied driving phase

The following tables provide an insight into the (most frequently) used vehicles during the accompanied driving phase.

Reflecting the rapid advances in vehicle safety systems (in particular the ever greater prevalence of ABS and ESP) in recent years, vehicles which are around nine or more years old are described as "old" in the present study. In this sense, 35.7% of the male participants and 36.3% of the female participants drove an old or even a very old vehicle (Tab. 56).

The age structure of all vehicles entered in the central vehicle register on 1st January 2008 was not greatly different from that of the vehicles used by AD17 participants (Kraftfahrt-Bundesamt, 2008a, applying the age classifications used here: 22% "new", 39% "average", 29% "old" and 10% "very old"). One tendency was noticeable, however: New and very old vehicles were used proportionally less often for accompanied driving practice, while vehicles of "average" age were used more often. The concern that AD17 drivers may have to rely on particularly old and possibly unsafe vehicles is thus unfounded: The age of the vehicles used compares well with the average age of all vehicles in Germany.

Most of the young drivers were provided with a vehicle with respectable engine power for their driving practice during the accompanied phase (Tab. 57): Around 80% of the male participants and around three-quarters of the female participants were able to use a vehicle with an engine power of more than 50 kW. An already quite "sporty" engine power of more than 80 kW was available to around 31% of the female participants and even 38% of the male participants. This is less surprising, however, considering that the vehicle generally belonged to the participant's parents; novice drivers owned the vehicle in only around 6% of the cases (Tab. 58).

The overall distribution of engine powers compares well with that identified from KBA records for all vehicles in Germany as per 1st January 2008: the

Which vehicle did you drive most frequently during the period of accompanied driving*?			
Year of first registration	Male in %	Female in %	Total in %
2007 to 2005 ("new")	17.8	17.0	17.4
2004 to 1999 ("average")	44.4	44.5	44.4
1998 to 1993 ("old")	28.4	29.9	29.2
Before 1993 ("very old")	7.3	6.4	6.8
No (valid) data provided	0.2	0.1	0.1
No vehicle (see footnote 58)	1.9	2.1	2.0
Total	100	100	100
* = Accompanied phase ended between March and August 2007			

Tab. 56: Most frequently used vehicle during the accompanied driving phase by vehicle age, differentiated by driver gender

Which vehicle did you drive most frequently during the period of accompanied driving?			
Engine power in kW	Male in %	Female in %	Total in %
Up to 50 kW	17.4	23.3	20.7
51 to 80 kW	42.3	43.4	42.9
81 to 110 kW	29.3	24.7	26.7
Over 110 kW	8.7	6.1	7.3
No data provided	0.4	0.5	0.4
No vehicle (see footnote 58)	1.9	2.1	2.0
Total	100	100	100

Tab. 57: Most frequently used vehicle during the accompanied driving phase by engine power, differentiated by driver gender

Which vehicle did you drive most frequently during the period of accompanied driving?			
Vehicle owner	Male in %	Female in %	Total in %
Self (AD17 participant)	6.0	6.2	6.1
Parents	88.8	87.8	88.2
Other relative	2.3	2.6	2.5
Other person	1.0	1.1	1.1
No data provided	0.1	0.0	0.1
No vehicle (see footnote 58)	1.9	2.1	2.0
Total	100	100	100

Tab. 58: Most frequently used vehicle during the accompanied driving phase by vehicle owner, differentiated by driver gender

distribution across the four engine power classes in the official statistics are 19%, 42%, 28% and 11% (Kraftfahrt-Bundesamt, 2008b). The only noticeable deviation from these figures in the present study occurred for engine powers over 110 kW (see Tab. 57): Vehicles with such power (and in this price category) were less frequently entrusted to novice drivers.

Driving practice during the accompanied phase

For the expected effectiveness of the model, the overall duration of the accompanied phase shown in Tab. 51 is probably less important than the actual driving practice obtained in this period. A cautiously estimated demand regarding the minimum driving practice during the accompanied driving phase, based on the average practice during normal driver training[51], is at least 25 hours of driving time. Assuming a mean vehicle speed[52] of 40 km/h across all road types, this corresponds to a driving distance of 1,000 kilometres. Other countries where minimum requirements or recommendations are specified (e.g. Austria, France and Norway) require at least 2,000 to 3,000 km or even 5,000 to 7,000 km of accompanied driving (see European Conference of Ministers of Transport, 2006, p. 132ff). Even the comparatively modest threshold of 1,000 kilometres was reached by only 51.2% of the male drivers and even a mere 37.9% of the female drivers (Tab. 59). A wholly inadequate distance of less than 100 km over the whole phase of accompanied driving was reported by 5.0% of the male participants and 8.4% of the female participants. These figures each include around two per cent of participants with practically no driving practice whatsoever.[53]

It is problematic in this context, as suggested by the open comments at the end of the questionnaire, that many survey respondents found it very difficult to estimate the total number of kilometres driven, especially in retrospect. The distances specified are thus probably imprecise and should not be taken too literally. Based on the available, coarsely classified data, the average total distance driven during the accompanied driving phase was approximately 1,800 kilometres (though this estimate is subject to all mentioned provisos). According to the more exact data of the AD17 process evaluation by FUNK und GRÜNINGER (2010, Chapter 5.5), which were based on the weekly records of approx. 3,200 participants, the calculated accompanied driving practice was higher by almost half, namely 2,770 kilometres.[54]

The weekly driving time is a measure of the "intensity" of AD17 participation. Three or more hours per week were invested in accompanied driving by 52.0% of the male participants and 47.1% of the female participants (Tab. 60); at the same time, however, a remarkable 23.3% of the male drivers and even 28.3% of the female

51 see FUNK, SCHNEIDER, ZIMMERMANN & GRÜNINGER, 2007, p. 71, for persons who obtained a driving licence at the age of 18 years

52 According to the data of a survey on mobility in Germany (Bundesministerium für Verkehr, Bau und Stadtentwicklung, 2010), the average "system speed" for individual road traffic is 42 km/h (there Fig. 95; average distance travelled divided by average journey time; own calculation).

53 In the following tables on the accompanied driving phase, it is assumed that participants with only negligible practical experience had no vehicle available and were thus unable to provide information on driving practice and the primarily used vehicle.

54 Own calculation: The average time of joining the AD17 model is given as 5.1 months after a person's 17th birthday (Chapter 4.2). That equates to an average duration of the accompanied driving phase of 6.9 months. Based on an average daily distance driven of 13.2 km (Chapter 5.5.1.1), this produces a total distance of 2,770 km. Elsewhere (Chapter 5.5.3, Fig. 5-68), however, a considerably lower value of 2,060 km can be read for persons with 7 months participation. Readers are referred to the study itself regarding the methods used, closer analyses and further conclusions.

How many kilometres did you drive in total during the phase of accompanied driving?			
Kilometres	**Male in %**	**Female in %**	**Total in %**
None or max. 10 km	1.9	2.1	2.0
11 to 100 km	3.1	6.3	4.9
101 to 200 km	5.9	9.7	8.0
201 to 500 km	14.2	20.9	17.9
501 to 1,000 km	23.3	23.0	23.1
1,001 to 2,500 km	24.1	20.0	21.8
2,501 to 5,000 km	16.3	11.6	13.7
5,001 to 10,000 km	8.0	4.9	6.3
More than 10,000 km	3.2	1.4	2.2
No valid data provided	0.2	0.3	0.2
Total	100	100	100

Tab. 59: Total distance driven during the accompanied driving phase, differentiated by driver gender

drivers reported a maximum of only one hour of driving practice per week. Taking the category mean values from Tab. 60 (for example 6 hours for the category “5 to 7 hours”, and an arbitrary 18 hours for the category “More than 15 hours”), overall mean values can be calculated: On this basis, the calculated average weekly driving time was 3.5 hours for male AD17 participants and 3.0 hours for female AD17 participants. Here,too, the aforementioned reservations concerning retrospective estimates must be taken into account.

FUNK and GRÜNINGER (2010, Chapter 5.6.1.1, Fig. 5-74) reported a daily average of 12.6 minutes on the basis of detailed weekly reports from their sample of approx. 3,200 AD17 drivers; this translates into a much lower weekly average of only 1.5 hours. However, if the average calculated here, namely 3.25 hours per week, is used over the average duration of the accompanied driving phase of 28.7 weeks, this results in a total of 93 hours, which compares well with the experience gained in Sweden: BERG (2005) reports an average of 118 hours for the Swedish model (calculated within the framework of the model evaluation at that time; today only 73 hours). For comparison: Australia recommends 200 hours and prescribes an absolute minimum of 120 hours (European Conference of Ministers of Transport, 2006, p. 134).

The drivers responding to the survey estimated that approx. 46% of their accompanied driving practice was on roads within built-up areas, 36% on roads outside built-up areas (excluding motorways) and 17% on motorways (Tab. 61). Some 29% of the male drivers estimated that more than half of their accompanied driving was on roads within built-up areas, compared to 17% reporting the same for

How many hours did you spend driving per week during the phase of accompanied driving?			
Hours per week	**Male in %**	**Female in %**	**Total in %**
Up to one hour	23.3	28.3	26.1
Approx. 2 hours	22.8	22.6	22.7
Approx. 3 hours	18.9	19.1	19.0
Approx. 4 hours	8.8	9.4	9.1
Approx. 5 to 7 hours	15.6	12.1	13.6
8 to 10 hours	5.4	4.4	4.9
11 to 15 hours	2.1	1.1	1.6
More than 15 hours	1.2	0.9	1.0
No data provided	0.0	0.0	0.0
No vehicle (see footnote 58)	1.9	2.1	2.0
Total	100	100	100

Tab. 60: Weekly driving time during the accompanied driving phase, differentiated by driver gender

Which roads were used during the phase of accompanied driving?			
Type of road	**Male in %**	**Female in %**	**Total in %**
Roads within built-up areas			
None	0.2	0.1	0.1
Proportion from 1 to 25%	17.1	13.2	14.9
Proportion from 26 to 50%	53.3	54.0	53.7
Proportion from 51 to 75%	21.1	22.4	21.8
Proportion from 76 to 100%	6.2	8.1	7.3
No data provided	0.1	0.1	0.1
No vehicle (see footnote58)	1.9	2.1	2.0
Total	100	100	100
Mean of this road type	45	47	46
Roads outside built-up areas (excluding motorways)			
None	0.7	0.9	0.8
Proportion from 1 to 25%	31.8	30.8	31.3
Proportion from 26 to 50%	48.0	49.5	48.8
Proportion from 51 to 75%	15.3	14.5	14.9
Proportion from 76 to 100%	2.1	2.0	2.1
No data provided	0.1	0.1	0.1
No vehicle (see footnote 58)	1.9	2.1	2.0
Total	100	100	100
Mean of this road type	36	37	36
Motorways			
None	9.0	13.1	11.3
Proportion from 1 to 25%	63.7	65.5	64.7
Proportion from 26 to 50%	22.2	17.4	19.5
Proportion from 51 to 75%	2.5	1.6	2.0
Proportion from 76 to 100%	0.3	0.1	0.2
No data provided	0.3	0.2	0.3
No vehicle (see footnote 58)	1.9	2.1	2.0
Total	100	100	100
Mean of this road type	19	16	17

Tab. 61: Proportions of different road types used during the accompanied driving phase, differentiated by driver gender

roads outside built-up areas and only 2% doing the majority of their driving on motorways. The corresponding figures for female drivers indicate a slightly greater proportion of driving practice within built-up areas, but a slightly smaller proportion on motorways. There was practically no difference between the genders with regard to driving practice on normal roads outside built-up areas.

The proportions of persons who reported no driving within built-up areas or on normal roads outside built-up areas were negligibly small at 0.1% and 0.8%, respectively. On the other hand, the proportions of young drivers who never used motorways during their phase of accompanied driving, namely 9.0% of the male drivers and even 13.1% of the female drivers, must be considered too high against the objective of gaining everyday driving practice.

Accidents and traffic offences during the accompanied driving phase

Around 12% of the AD17 drivers with access to a vehicle reported fines for traffic offences or even accident involvement during the accompanied driving phase. If minor damage due to mistakes in connection with parking is discounted, however, this figure is reduced to 4.7%. The various incident categories, differentiated by driver gender, are shown in Tab. 62. With the exception of damage in connection with parking, female novice drivers performed slightly better than their male counterparts.

Traffic offences penalised with a fine of €40 or more and penalty points in the Central Register of Traffic Offenders (VZR) were reported by 0.6% of the drivers; accidents with damage worth €1,000 or more or injury to persons were reported by 1.8% of the drivers.[55] For comparison: According to GREGERSEN and NYBERG (2002), around three per cent of the drivers in Sweden reported accident involvement during the accompanied driving phase; contrary to expectation, the results for male drivers were scarcely worse than for female drivers in both countries.

The information on accident involvement and traffic offences from the survey was supplemented by data retrieved from the Central Register of Traffic Offenders (VZR) for AD17 drivers for the phase of accompanied driving. Apart from one case of licence withdrawal, the “officially” registered traffic offences were marginal (Tab. 63). Only nine of over

Were you penalised for any traffic offences or were you involved in any accident during the phase of accompanied driving?	Male in %	Female in %	Total in %
Cautionary fine (from €15 but less than €40)	3.5	2.2	2.8
Recorded fine (€40 or more)	0.9	0.4	0.6
Minor damage due to a mistake on my part in connection with parking	5.5	8.0	6.9
Damage up to €1,000 (irrespective of fault), but without injury to persons	1.7	1.9	1.8
Damage of €1,000 or more (irrespective of fault), but without injury to persons	1.9	1.3	1.5
Injury to persons (irrespective of fault)	0.5	0.5	0.5
None of the above	86.7	86.2	86.5
No vehicle (see footnote 58)	1.9	2.1	2.0
Total*	103	103	103
* = Total exceeds 100% as multiple responses were possible			

Tab. 62: Accident involvement and traffic offences during the accompanied driving phase, differentiated by driver gender

Persons with VZR data records relating to ...	Male	Female	Total
... at-fault accidents[1]	3	2	5
... traffic offences[2]	9	4	13
... driving licence withdrawal	1	0	1
... driving bans	0	0	0
... required participation in further training measures	9	1	10
... voluntary participation in further training measures	0	0	0
Persons in Ek group, total*	4,237	5,275	9,412
[1] “VZR accidents”; [2] “VZR offences” (including VZR accidents, see Section 2.1.3; * = excluding 77 male drivers and 32 female drivers not clearly identified in the VZR records			

Tab. 63: Persons with entries in VZR data records relating to car driving during the accompanied driving phase, differentiated by driver gender

[55] Slight deviation from Tab. 62 due to the possibility of multiple responses

4,000 male drivers and only four of over 5,000 female drivers committed traffic offences associated with an entry in the VZR during their phase of accompanied driving. This represents on average a rate of 0.14 per cent, which is an absolutely negligible value. It is remarkable that these figures account for only a quarter of the self-reported offences penalised with a recorded fine (cf. Tab. 62).[56]

Conclusion

The chosen accompanying passenger was almost exclusively a parent (97% of cases). Consequently, the most commonly used vehicle was the parent's vehicle. This underlines the importance of parental support for the AD17 model. The age and engine power of the primarily used vehicles follows the corresponding proportions of all vehicles registered in Germany very closely.

As expected, the rates of self-reported involvement in accidents and traffic offences are low at around 5%, if minor damage in connection with parking is excluded. The rate of VZR offences, in other words cases in which a significant or serious infringement of traffic rules was recorded “officially”, was lower still, namely below one per cent. It is reasonable, however, to assume systematic under-reporting in this context.

With regard to the intended purpose of the AD17 model, it is alarming that around two percent of the novice drivers had no vehicle available during the accompanied driving phase and were thus unable to gather driving practice. The intensity of driving practice was also less than satisfactory in the approx. 25% of cases where participants reported one hour or less of driving per week. More than 10% of the young drivers never used motorways during their accompanied driving. Overall, around 50% of the male drivers and around 60% of the female drivers failed to reach even the modest threshold of 1,000 kilometres of accompanied driving practice. This alarming rate may be partially due to the often very short accompanied driving phase. In fact, the result would presumably be even less satisfactory if the substantial proportion of AD17 participants not considered by the present study, namely those with an accompanied driving phase less than three months, were also to be taken into account.

5.4 The first year of solo driving

This section describes the findings derived from the survey results with regard to the first months of solo driving. This period begins with the start of solo driving, namely the novice driver's 18th birthday for the Ek group and with receipt of a full driving licence during the first quarter after the driver's 18th birthday for the Kk group. It ends with completion of the questionnaire of the initial survey. The duration of this period was on average seven months (see Tab. 18). When completing the initial survey, therefore, the respondents were looking back over an average of seven months of solo driving practice.

The large samples mean that differences of even a few percentage points are already statistically significant. Differences emphasised in the text thus generally possess statistical significance, even where this is not stated explicitly. It is not necessary to distinguish by gender when comparing the data for the Ek and Kk groups, because the gender proportions in both groups were practically identical and at the same time approximately balanced: The proportion of female drivers in the Ek group was 56% compared to 54% in the Kk group.

Sample size	N = 20,346
Data source	Online questionnaire (18,762), Paper questionnaire (1,584)
Analysis groups	Ek (9,521) and Kk (10,825)
Analysis period	Initial survey

Tab. 64: Analysis conditions and number of cases considered in Section 5.4 to describe the first year of driving

56 The fact that “under-reporting” of penalised traffic offences occurs outside the accompanied driving phase, namely during the phase of solo driving, suggests that not all traffic offences were correctly assigned to the actual driver in the VZR; it is quite probable that the mother or father, as the accompanying passenger, took blame for the committed offence wherever possible. This notion is furthermore supported by the fact that it is generally the parents, as the owners of the vehicle, who receive penalty notifications and who probably accept a considerable co-responsibility for the accompanied driver's behaviour and also pay the actual fine. It is thus reasonable to assume considerable VZR under-reporting of at least 75% during the accompanied driving phase (based on comparison of the figures in Tab. 62 and Tab. 63).

5.4.1 Vehicle use in the first year of solo driving

The start of solo driving is the most dangerous period of a person's driving career: The accident risk is very high during the first months of driving practice, but then declines rapidly (SCHADE, 2001). Especially in the case of “early beginners”, two key sources of risk coincide: Novice risk and youth risk (WILLMES-LENZ, 2002). It is thus particularly important to obtain information on risk exposure during this phase, namely on the extent of participation in road traffic and vehicle use.

Most of the approx. 20,000 novice drivers considered in this section had gained between four and ten months of driving experience (see Fig. 19).

For comparison, reference is made in this section to the results of the 2005 novice driver survey by FUNK, SCHNEIDER, ZIMMERMANN and GRÜNINGER (2007). The samples of that survey and the present study compare well when the former is reduced to the separately identified group of around 3,000 18-year-old persons[57]: The male proportion is there 49% (derived from Tab. 4-19), compared to 45% here. The period since receipt of a driving licence is there 6.0 months (derived from Tab. 4-17), compared to 6.8 months here.

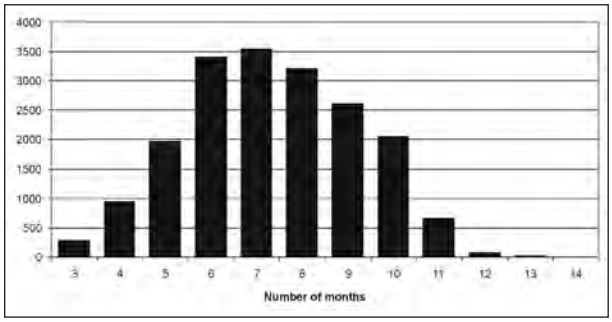

Fig. 19: Persons considered by the analysis in this section, differentiated by the number of months since the start of their solo driving

Vehicle availability

The following tables provide an insight into the most frequently used vehicles during the first year of solo driving. At the time of the survey, however, 3.8% of the persons in the Ek group and 8.8% of the persons in the Kk group had no vehicle available[58]. For comparison: FUNK et al. (2007) found that only 2.3% had no vehicle available during the corresponding reporting period (from Fig. 5-20).

Reflecting the rapid advances in vehicle safety systems (in particular the ever greater prevalence of ABS and ESP) in recent years, vehicles which are approximately nine or more years old are defined as “old” in the present study. Following this definition, over 38% of the respondents were driving an old or even very old vehicle during the first year of their solo driving career (Tab. 65). It is necessary, however, to take into account the proportions of drivers who did not specify the year of first registration of their vehicle; this pertains particularly to Kk group, where this proportion was very high at 15%. Over seven per cent of the responses were not usable; the remaining eight per cent did not provide data. In many cases, the survey respondent did not go to the trouble of determining the year of registration from the vehicle documents, as was occasionally mentioned in the comment field of the questionnaire.

Insofar as valid responses were given, the (former) AD17 participants reported using vehicles which were on average one year younger: The mean vehicle age in their case was 7.6 years (median 8

Which vehicle are you now most frequently able to use since commencing solo driving?			
Year of first registration	Ek in %	Kk in %	Total in %
2007 to 2005 (“new”)	15.5	10.3	12.7
2004 to 1999 (“average”)	33.9	26.7	30.1
1998 to 1993 (“old”)	31.1	30.3	30.7
Before 1993 (“very old”)	7.2	8.6	7.9
No valid data provided	7.5	7.1	7.3
No data provided	1.0	8.2	4.8
No vehicle (see footnote 58)	3.8	8.8	6.5
Total	100	100	100

Tab. 65: Most frequently used vehicle during the first year of solo driving by vehicle age, differentiated by the choice of driving licence model

[57] Age at which the driving licence was obtained; there termed the group “17 or 18-year-olds”, because not all had already passed their 18th birthday

[58] This circumstance can unfortunately only be deduced from the fact that these respondents gave no answers to any of the vehicle-related questions (there was unfortunately no question which explicitly addressed the availability of a vehicle; the respondent was instead asked to simply leave out the corresponding questions).

years) compared to 8.5 years (median 9 years) in the group with a licence obtained in the conventional manner. For comparison: The mean vehicle age for all vehicles entered in the central vehicle register at the KBA on 1st January 2008 was 8.0 years (Kraftfahrt-Bundesamt, 2008a); applying the age classifications used here in Tab. 65, the age distribution in the central register was 22% “new”, 39% “average”, 29% “old” and 10% “very old” vehicles.

The survey respondents were even less prepared to ascertain the mileage reading of the vehicle used: 7.5% of the Ek group and 13.5% of the Kk group failed to provide (usable) data (regarding plausibilities, see Section 2.4). This implies a slightly higher willingness to cooperate among the former AD17 participants, as also displayed in many other instances.

Where data were provided, the average mileage was 103,000 km (Tab. 66). The mean value for the Ek group was slightly higher by 4%, that for the Kk group slightly lower by 4%. Some 5.2% of the persons in the Ek group and 3.6% of the persons in the Kk group reported driving with relatively new vehicles (mileage reading up to 10,000 km).

Most of the young drivers had access to a vehicle with respectable engine power for the first year of their driving career (Tab. 67): Around 50% of the drivers with a licence obtained in the conventional manner and even 64% of the former AD17 participants were able to use a vehicle with an engine power of more than 50 kW and corresponding acceleration. An already quite “sporty” engine power of more than 80 kW was available to over 20% of the former AD17 participants and almost 14% of those who underwent conventional driver training. Compared to the vehicle engine powers available during the phase of accompanied driving (see Tab. 57), however, these figures lie within a much more modest range (compare also the previously mentioned figures from the official statistics for the same categories, namely 19%, 42%, 28% and 11%).

The vehicle owner structure changed greatly compared to the accompanied driving phase. Whereas almost 90% of the vehicles were at that time owned by the novice driver's parents (cf. Tab. 58), this proportion is reduced to just under 60% for the phase of solo driving (Tab. 68). In one-third of cases, the vehicles now belonged to the novice drivers themselves. The differences between the analysis groups were only small. For comparison: The results in FUNK et al. (2007, Fig. 5-16) show that around 42% of the approx. 3,000 18-year-old

Which vehicle are you now most frequently able to use since commencing solo driving?			
Mileage reading of vehicle	Ek	Kk	Total
	Proportions in %		
Up to and including 10,000 km	5.2	3.6	4.3
Over 10,000 up to and including 20,000 km	5.1	3.9	4.4
Over 20,000 up to and including 40,000 km	9.2	6.5	7.8
Over 40,000 up to and including 80,000 km	20.8	16.8	18.7
Over 80,000 up to and including 160,000 km	34.3	32.9	33.5
Over 160,000 up to and including 320,000 km	13.2	13.3	13.2
Over 320,000 km	0.9	0.8	0.9
No (valid) data provided	7.5	13.5	10.7
No vehicle (see footnote 58)	3.8	8.8	6.5
	Mileage in km x 1,000		
1st percentile	3	3	3
5th percentile	9	11	10
Median	89	98	92
95th percentile	222	228	225
99th percentile	326	330	327
Mean	99	107	103

Tab. 66: Mileage reading of the most frequently used vehicle during the first year of solo driving, differentiated by the choice of driving licence model

Which vehicle are you now most frequently able to use since commencing solo driving?			
Engine power in kW	Ek in %	Kk in %	Total in %
Up to 50 kW	31.0	33.0	32.1
51 to 80 kW	43.5	36.2	39.6
81 to 110 kW	17.0	11.4	14.0
Over 110 kW	3.5	2.2	2.8
No data provided	1.1	8.4	5.0
No vehicle (see footnote 58)	3.8	8.8	6.5
Total	100	100	100

Tab. 67: Most frequently used vehicle during the first year of solo driving by engine power, differentiated by the choice of driving licence model

Which vehicle are you now most frequently able to use since commencing solo driving?			
Vehicle owner	Ek in %	Kk in %	Total in %
Self	33.6	32.1	32.8
Parents	58.2	52.6	55.2
Other relative	2.6	3.7	3.2
Other person	1.5	2.0	1.8
No data provided	0.4	0.7	0.5
No vehicle (see footnote 58)	3.8	8.8	6.5
Total	100	100	100

Tab. 68: Most frequently used vehicle during the first year of solo driving by vehicle owner, differentiated by the choice of driving licence model

Which vehicle are you now most frequently able to use since commencing solo driving?			
Principal user of the vehicle	Ek in %	Kk in %	Total in %
Exclusively self	22.7	23.6	23.2
Mainly self	34.9	30.5	32.5
Mainly parents	35.2	31.7	33.4
Mainly other person	2.4	3.8	3.2
No data provided	1.0	1.6	1.2
No vehicle (see footnote 58)	3.8	8.8	6.5
Total	100	100	100

Tab. 69: Most frequently used vehicle during the first year of solo driving by principal vehicle user, differentiated by the choice of driving licence model

novice drivers surveyed were themselves owner of the vehicle.

Over 50% of the young drivers are either the principal or even the exclusive user of the vehicle driven (Tab. 69). For comparison: FUNK et al. (2007, Fig. 6-22) report that even approx. 62% of the approx. 3,000 18-year-old novice drivers surveyed described themselves as the main user of the vehicle.

According to the subjective assessments of the drivers, their vehicles are mainly in good technical condition (Tab. 70). This assessment was reported by 70% of the former AD17 participants, but only 60% of those with a licence obtained in the conventional manner. The differences between the analysis groups in further categories were small. Only around one per cent of the drivers doubted that their vehicle would pass its next technical inspection. In contrast, 64.5% were of the opinion that no repairs would be required in connection with a forthcoming inspection. In FUNK et al. (2007, Fig. 6-22), this opinion was expressed by even 72% of the approx. 3,000 18-year-old novice drivers surveyed. For comparison: According to official statistics on defects revealed by technical inspections for 2007[59], only around half of the vehicles were without defects; 33% of the vehicles presented for inspection displayed minor defects and 17% major defects up to the state of being unsafe to drive.

The general availability of vehicles in the households of “early beginners” was outstanding. The primarily used vehicle was rarely the only vehicle in the household: 70% of the Kk group and

Which vehicle are you now most frequently able to use since commencing solo driving? How much maintenance work would be required if a technical inspection (TÜV, DEKRA) were due tomorrow?			
Work required	Ek in %	Kk in %	Total in %
No work, vehicle is in good technical order	69.6	60.1	64.5
Minor work, vehicle is generally in good technical order	22.7	24.9	23.9
Some work, vehicle has defects	2.1	2.8	2.5
Major work, as it is unlikely that the vehicle would pass a technical inspection	0.9	1.2	1.0
No data provided	0.8	2.2	1.5
No vehicle (see footnote 58)	3.8	8.8	6.5
Total	100	100	100

Tab. 70: Most frequently used vehicle during the first year of solo driving by technical condition of the vehicle differentiated by the choice of driving licence model

even 79% of the Ek group reported that at least one other vehicle was available for private use in addition to the primarily used vehicle (Tab. 71). It should not be surprising if early beginners tend to belong to environments with a particular affinity for driving.

No or only one vehicle in the household was reported by 27.3% of the Kk group, but only 20.3% of the Ek group. This is a small pointer to the slightly more affluent households to which former AD17

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Are further vehicles available in the household for private use (in addition to the vehicle described above)?			
Further vehicles in the household	Ek in %	Kk in %	Total in %
No vehicle at all	3.8	8.8	6.5
No further vehicle	16.5	18.5	17.6
One further vehicle	46.0	41.4	43.5
Two or more further vehicles	32.8	28.9	30.7
No data provided	0.9	2.4	1.6
Total	100	100	100

Tab. 71: Number of vehicles available in the household during the first year of solo driving, differentiated by the choice of driving licence model

participants belong. This assumption is corroborated by the lower average age of the vehicle used (see Tab. 65) and the higher average engine power in this group (see Tab. 67).

A comparison with the data gathered by the survey "Mobility in Germany 2002" (Bundesministerium für Verkehr, Bau- und Wohnungswesen, 2003) confirms the assumption that early beginners generally tend to come from households with several vehicles. Assuming that the 18-year-old drivers live in households of at least four persons[60], the following proportions are to be expected: 3% without vehicle, 40% with one, 44% with two and 13% with more than two vehicles. However, this level of vehicle availability is by far exceeded in the "early beginner households" (though changes in the economic situation during the past five years cannot account for these figures).

Driving practice

There is little difference between the Ek and Kk groups in terms of the kilometres driven per week (Tab. 72). If the specified practice is extrapolated for a whole year, this produces a very moderate annual total for the first year of solo driving of approx. 8,700 kilometres for former AD17 drivers and approx. 8,300 kilometres for those with a licence obtained in the conventional manner. STIENSMEIER-PELSTER (2007) reported comparable values for the first quarter of solo driving in his evaluation of

How many kilometres do you now drive yourself per week on average?			
Kilometres per week	Ek	Kk	Total
	Proportions in %		
None	0.7	0.8	0.8
1 to 10 km	3.1	4.6	3.8
11 to 25 km	6.8	7.5	7.2
26 to 50 km	17.1	17.0	17.0
51 to 100 km	21.5	20.8	21.1
101 to 200 km	23.0	23.1	23.0
201 to 400 km	19.0	18.0	18.5
401 to 800 km	7.0	6.1	6.5
801 to 1,600 km	0.4	0.4	0.4
Data not plausible	1.4	1.5	1.5
No data provided	0.2	0.2	0.2
Total	100	100	100
	Distance in km		
Median	110	100	100
5th percentile	15	10	15
95th percentile	500	500	500
Mean	167	159	163
Corresponding to an annual distance driven of approx	8,700	8,300	8,500

Tab. 72: Kilometres driven per week during the first year of solo driving, differentiated by the choice of driving licence model

the AD17 model in Lower Saxony: The extrapolated annual figures were here 7,680 kilometres for the AD17 drivers and 7,400 kilometres for those with a licence obtained in the conventional manner (n = 4,454 and 2,421, respectively).

SKOTTKE et al. (2008, Fig. 4) calculate similar annual driving practice of approximately 9,000 kilometres for the first 12 months after issuing of a driving licence for a sample of 800 holders of a probationary driving licence aged between 18 and 24 years (monthly distance driven approx. 750 kilometres). FUNK et al. (2007), on the other hand, found a relatively constant average daily distance of 31 kilometres[61] for approx. 2,800 18-year-old novice drivers over the first 12 months. This corresponds to an annual distance driven of around 11,000 kilometres.

Alongside the distance driven, the weekly driving time is a further measure of the intensity of participation in road traffic and thus of exposure to

60 Only few of the young drivers live in single or two-person households. In such cases, as likewise in three-person households, the vehicle availability would be less favourable than that described here.

61 Own calculation based on Table 5-4

risk. An average of three or more hours of driving per week was reported by 65% of the Ek group and 60% of the Kk group (Tab. 73). At the same time, 16% of the Ek group and over 20% of the Kk group manage no more than one hour of driving practice per week. This suggests a slightly higher driving time among the former AD17 participants. Taking the category mean values from Tab. 73 (for example 6 hours for the category “5 to 7 hours”, and an arbitrary 18 hours for the category “More than 15 hours”), overall mean values can be calculated: On this basis, the average weekly driving time was 4.4 hours for the Ek group and 4.1 hours for the Kk group.

A comparison with the phase of accompanied driving shows a significant increase in the Ek group: While only 50% of the drivers reported three or more hours of accompanied driving, this figure rose to 65% after the start of solo driving; similarly only 16% reported a maximum of one hour of solo driving practice per week, compared to 26% during the phase of accompanied driving (cf. Tab. 60).

The novice drivers estimated that on average around 48% of their practice during the initial phase of solo driving was on roads within built-areas, 36% on normal roads outside built-up areas and 16% on motorways (Tab. 74). The drivers of the Kk group reported a slightly greater proportion of driving within built-up areas, but a correspondingly smaller proportion on motorways.

How many hours do you now spend driving per week on average?			
Hours per week	**Ek in %**	**Kk in %**	**Total in %**
Up to one hour	16.1	20.5	18.4
Approx. 2 hours	17.8	18.6	18.2
Approx. 3 hours	16.6	16.7	16.7
Approx. 4 hours	12.5	11.0	11.7
Approx. 5 to 7 hours	21.1	19.4	20.1
8 to 10 hours	9.1	7.6	8.3
11 to 15 hours	3.4	3.1	3.2
More than 15 hours	2.0	1.8	1.9
Data not plausible	1.4	1.5	1.5
Total	100	100	100

Tab. 73: Weekly driving time during the first year of solo driving, differentiated by the choice of driving licence model

While the proportions of drivers who report no driving within built-up areas or no driving outside built-up areas are minor, the proportion of young drivers who never used a motorway during their first months of solo driving seems remarkably high, namely 9.4% in the Ek group and even 16.7% in the Kk group.

In the group of former AD17 participants, this proportion of “motorway avoiders” is practically unchanged compared to the accompanied driving

On which type of roads do you generally drive?			
Type of road	**Ek in %**	**Kk in %**	**Total in %**
Roads within built-up areas			
None	0.1	0.2	0.2
Proportion from 1 to 25%	17.0	14.2	15.5
Proportion from 26 to 50%	53.2	47.6	50.2
Proportion from 51 to 75%	21.9	24.3	23.2
Proportion from 76 to 100%	7.5	13.3	10.6
No data provided	0.3	0.3	0.3
Total	100	100	100
Mean of this road type	45	50	48
Roads outside built-up areas (excluding motorways)			
None	1.5	2.6	2.1
Proportion from 1 to 25%	31.2	33.3	32.3
Proportion from 26 to 50%	48.1	43.3	45.6
Proportion from 51 to 75%	16.6	17.3	17.0
Proportion from 76 to 100%	2.3	3.2	2.8
No data provided	0.3	0.4	0.3
Total	100	100	100
Mean of this road type	37	36	36
Motorways			
None	9.4	16.7	13.3
Proportion from 1 to 25%	67.3	66.6	66.9
Proportion from 26 to 50%	19.7	13.2	16.2
Proportion from 51 to 75%	2.7	2.3	2.5
Proportion from 76 to 100%	0.5	0.4	0.4
No data provided	0.4	0.9	0.7
Total	100	100	100
Mean of this road type	18	14	16

Tab. 74: Proportions of different road types used during the first year of solo driving, differentiated by the choice of driving licence model

phase. An additional evaluation for this group showed that reservations towards motorway driving in the accompanied driving phase are carried over to the subsequent phase of solo driving: Of those who used a motorway during the accompanied driving phase, only 4.0% have not (yet) used motorways since the start of solo driving. Of those who never used a motorway during the accompanied driving phase, however, 48.9% have still not driven on motorways.

Conclusion

Some 4% of the former AD17 participants and 9% of the drivers with a licence obtained in the conventional manner did not (yet) have a vehicle available for their use in the first months of solo driving. Apart from this group, the unusually high level of vehicle availability in the households of young novice drivers was remarkable.

In comparisons with the accompanied driving phase, the young drivers were more frequently the principal or even exclusive user of the available vehicle and more frequently themselves the vehicle owner. The engine power of the vehicles used was significantly below the German average, but the vehicles were not older. Driving practice during the first months of solo driving remained moderate: Extrapolation of the reported practice produced a mean annual distance driven of 8,500 km. The (minor) differences between the analysis groups in this respect must be taken into account in the later interpretation of evaluation results.

5.4.2 Differences in the first year of solo driving between AD17 participants and those choosing the conventional licence model

Section 5.2 identified factors which co-determine the choice of a particular driving licence model. It can thus be expected that the persons in the Ek and Kk groups differ inherently and independently of the practice gained during the accompanied driving phase. These differentiating factors include those which correlate with the evaluation criteria accidents and traffic offences. An example of how an unrecognised correlation could falsify the evaluation results was already given in Section 5.2.

It is consequently an important objective to exclude uncontrolled influences on the evaluation criteria accidents and traffic offences by differences between the groups which are not related to the intended subject of the evaluation, namely the practice gaining during the phase of accompanied driving. Such influence could otherwise conceal, cancel or even reverse the effect to be demonstrated.

The first step is therefore to test for differences between the groups which go beyond those already known. Possible factors are the primarily used vehicle[62] and the intensity of use in the early phase of solo driving; this data was collected by way of the initial survey. Vehicle use is after all the most important exposure factor relevant for the rates of accidents and traffic offences.

A separate logistic regression with the driving licence model (AD17 versus conventional) as independent variable was calculated for each use-related factor, whilst taking into account the factors gender, educational attainment and place of residence (urban versus rural). In other words, vehicle use was predicted on the basis of the chosen driving licence model (Ek group versus Kk group), whilst controlling for gender, educational attainment and place of residence. In this way, any contribution of the licence model to the prediction of vehicle use over and above that of the control variables could be identified.

All calculated regression coefficients which indicated a main effect for the factor “driving licence model” or an interaction of this factor with the control variables were tested for statistical significance. Given the multitude of tests and the associated inflation of the applied maximum alpha error of one per cent, testing was carried out nominally at a 0.1 per cent level. For significant regression coefficients, the odds difference was calculated (see Formulas 4 and 5 in Section 2.2.2).

The odds difference indicates by how much the probability of a particular factor manifesting in the Ek group is greater compared to the Kk group after compensation for the control variables. A fictitious example: If an odds ratio of 1.5 is identified for the factor “Owner of the vehicle used”, this means that the chance of a randomly selected person in the Ek group being a vehicle owner is 50% higher than for

62 The evaluation at this point excludes the factors “Technical condition of the primarily used vehicle” and “Availability of other vehicles in the household”, which were already considered in Section 5.2.2.

a randomly selected person in the Kk group. This greater chance is furthermore not attributable to differences in respect of gender, educational attainment or place of residence.

The numbers of cases considered in the individual logistic regression calculations are shown in Tab. 35, column N. These figures differ because no (valid) response was given at the corresponding point of the questionnaire in some cases. The results are presented in Tab. 75. All six main effects analysed were shown to be significant, but none of the interactions. On this basis, the former AD17 participants (Ek group) differed significantly from drivers who obtained their licence in the conventional manner (Kk group) in the following respects at the start of their solo driving careers (in order of the effect sizes, expressed in odds):

- They more frequently drove a vehicle with an engine power of more than 50 kW,
- they more frequently reported more than four hours driving time per week,
- they more frequently drove more than 200 km per week,
- they less frequently used a vehicle which was more than nine years old,
- they were more frequently the principal user of their vehicle,
- they were more frequently themselves vehicle owner.

Conclusion

The following overall picture emerges for the first year of solo driving: Compared to persons who obtained their driving licence in the conventional manner, former participants in the AD17 model were more frequently the principal user or even the owner of the vehicle used; the engine power of the vehicle used more frequently exceeded 50 kW, and the vehicle was less frequently more than nine years old. Former AD17 drivers more frequently spent more than four hours driving and also more frequently drove more than 200 km per week.

These differences are not attributable to differences between the groups in terms of gender, educational attainment or place of residence (urban/rural). Whilst differences are significant, they are of little practical relevance due to their small size. They should nevertheless be taken into account in the later interpretations of the evaluation results.

Phase of solo driving (dependent variables)	Regression coefficient	Odds difference* between Ek and Kk group
Age of primarily used vehicle (more than 9 years)	-0.125 sign.	-11.8%
Engine power of primarily used vehicle (more than 50 kW)	+0.145 sign.	+15.6%
Owner of primarily used vehicle (self)	+0.073 sign.	+7.6%
Principal user of primarily used vehicle (self)	+0.098 sign.	+10.3%
Distance driven per week (at least 200 km)	+0.119 sign.	+12.6%
Driving time per week (more than 4 hours)	+0.119 sign.	+12.7%
sign. = significant at 1 per cent level; n.s. = not significant * = odds difference (see Formula 5 in Section 2.2.2) Interpretation example: A person in the Ek group is 11.8% less likely to use a vehicle more than nine years old than a person in the Kk group		

Tab. 75: Differences between the Ek and Kk groups relating to vehicle use (based on logistic regression), over and above the influences of the variables gender, educational attainment and place of residence (urban/rural)

5.5 Driving behaviour as dependent on vehicle availability, attitudes, personality and parental role model

This section considers driving behaviour, measured by way of driving style and vehicle use, as a potentially important determinant for accident risk and traffic offences. The factors queried to characterise driving style and vehicle use (self-reported data) are presented in Tab. 76 together with the relevant evaluation categories. The responses were dichotomised to produce purely binary variables; the table indicates the positive case for each variable.

The question at this point concerns the extent to which driving style and vehicle use are dependent on framework conditions such as vehicle availability, attitudes, personality and parental role models.

The responses analysed were those given in the initial survey, i.e. after an average period of 6.8

Variable group Question	Categories and responses considered
Driving style	
How would you describe your driving style? My driving style is ...	safe (applicable or very applicable)
	sporty (applicable or very applicable)
	calm and composed (applicable or very applicable)
How would you describe your driving style compared to others of equal age and gender? Compared to others, I am ...	safer (applicable or very applicable)
	more cautious (applicable or very applicable)
	more attentive (applicable or very applicable)
	more willing to comply with traffic rules (applicable or very applicable)
Vehicle use	
How many kilometres do you drive yourself per week on average?	200 or more kilometres per week
How many hours do you spend driving per week on average?	More than 4 hours per week
On which type of roads do you generally drive? Proportions of each type:	Within built-up areas (excluding urban motorways) more than 50%
	Outside built-up areas (excluding motorways) more than 50%
	Motorways (including urban motorways) more than 33%
How much of your driving is done alone, with one passenger or with more than one passenger? Proportions in each case:	No passenger more than 50%
	One passenger more than 30%
	More than one passenger more than 10%

Tab. 76: Evaluation categories for variables relating to driving style and vehicle use

months of solo driving practice. No distinction was made between the Ek and Kk analysis groups. The required data on personality traits, however, were only collected in the intermediate survey; consequently, this aspect of the evaluation can only include those respondents who participated in both the initial and intermediate surveys. Tab. 77 provides an overview of the cases included in this analysis.

One simple and direct evaluation possibility is to determine the statistical correlation between pairs of variables. Individual correlations, however, are not really meaningful in the present case, as the analysis intends to show the joint influence of the whole set of variables. Multiple regression is the

Sample size	N = 8,480
Data source	Online questionnaire
Analysis groups	Only persons who participated in the intermediate survey: Ek (4,035) and Kk (4,445)
Analysis period	Initial survey (combined with data on

Tab. 77: Analysis conditions and number of cases relevant in Section 5.5

method of choice for such questions. In the following, therefore, logistic regressions are used (see Section 2.2.2). The dependent (binary) variable in each case is a variable describing driving style or vehicle use; the whole set of evaluated factors (vehicle availability, attitudes, personality, parental role models and gender) serves as independent variables or predictors.

The following tables (Tab. 78 and Tab. 79) show the dependent variables, namely driving style and vehicle use, in the header row and the set of independent predictor variables in the first column. A separate logistic regression (model without interactions) was calculated for each variable in the table header. The table contains the odds difference only for the effects of predictor variables with significant regression coefficients, and only if they exceed a certain threshold (odds difference greater than +25% or -20%, corresponding to a regression coefficient > 0.223 or < -0.223; calculation on the basis of Formula 5 in Section 2.2.2).

A sporty driving style appears to be influenced to the greatest degree by the predictor variables: Male drivers are almost twice as likely to describe their driving style as sporty compared to female drivers. A similarly strong influence for the development of a sporty driving style can be assigned to an extraverted personality, the appreciation of driving as “simply having fun” and the role model of a parent with a sporty driving style. The presence of the aforementioned indicators thus approximately doubles the likelihood of the novice driver developing a sporty driving style.

As expected, appreciation of the vehicle engine power is an especially meaningful predictor. A driver who pays particular attention to performance when purchasing a vehicle is three times more likely to develop a sporty driving style (odds difference 196%) than a person for whom engine power plays no particular role. It is remarkable in this context that the engine power of the vehicle actually used is apparently irrelevant with regard to driving style.

Driving style as dependent on …	My driving style is …			Compared to others, I am …			
	safe	sporty	calm/ composed	safer	more cautious	more attentive	more compliant
Vehicle availability (referring to the primarily used vehicle)							
Age (over 9 years)							
Engine power (more than 50 kW)							
Owner (self)							
Principal user (self)		+33%	-23%				
Technical condition (with defects)							
Further vehicles in household							
Attitude to vehicle (appreciation/purchase decision)							
Unrestricted mobility	+56%						
Simply have fun	+34%	+113%				+33%	
Performance		+196%	-38%	+31%			-20%
Consumption (low)							
Utility value			+71%		+38%	+33%	+28%
Safety	+94%				+57%		+92%
Gender (male)	+51%	+90%	-25%	+40%			
Personality							
Extraversion		+99%	-47%		-42%		-24%
Agreeableness			+54%				
Conscientiousness		-31%	+43%	+33%	+43%	+55%	+72%
Neuroticism	-44%		-42%	-30%		-27%	
Openness to experience		-22%					
Risk-taking propensity	-35%	+61%	-46%		-29%	-20%	-29%
Parental role model (driving style)							
Conscientious compliance: Father				+25%	+35%	+30%	+50%
Conscientious compliance: Mother					+38%	+26%	+29%
Sporty driving: Father		+98%					
Sporty driving: Mother		+129%		+36%		+39%	
Interpretation example: Respondents who especially appreciated unrestricted mobility were 56% more likely to describe their driving style as safer than others.							

Tab. 78: Influence of vehicle availability, attitudes to vehicle availability, gender, personality and parental role model on driving style, measured by the odds difference (only significant values and only if greater than +25% or -20 %, corresponding to regression coefficients > 0.223 or < -0.223; calculation on the basis of Formula 5 in Section 2.2.2)

Overall, it seems that personality "rubs off" on driving style alongside gender and parental role model. A tendency to conscientiousness produces a calm driving style and an above-average likelihood of safer, cautious, attentive and compliant driving; a higher risk-taking propensity, on the other hand, opposes this driving style. Risk-taking propensity at the same time favours a sporty driving style, whereas a tendency towards conscientiousness reduces the likelihood of developing such a style.

While driving style appears to be strongly dependent on attitudes, personality and parental role models (Tab. 78), these factors play almost no role for the intensity of vehicle use (Tab. 79). Actual vehicle use is rather more dependent on vehicle availability (the influence of which is in turn

Vehicle use as dependent on ...	Distance ≥ 200 km per week	Driving time > 4 hours per week	Driving outside built-up areas > 50%	Driving within built-up areas > 50%	Driving without passengers > 50%	Driving with ≥ 2 passengers > 10%
Vehicle availability (referring to the primarily used vehicle)						
Age (over 9 years)						
Engine power (more than 50 kW)				-20%		
Owner (self)	+79%	+54%			+44%	-30%
Principal user (self)	+392%	+376%	+49%	-32%	+31%	
Technical condition (with defects)						
Further vehicles in household			+43%	-36%		
Attitude to vehicle (appreciation/purchase decision)						
Unrestricted mobility						
Simply have fun		+37%	-28%			
Performance	+49%					
Consumption (low)						
Utility value						
Safety						
Gender (male)	+28%					+41%
Personality						
Extraversion						
Agreeableness						
Conscientiousness				-27%		
Neuroticism						
Openness to experience		-20%				
Risk-taking propensity		+34%				
Parental role model (driving style)						
Conscientious compliance: Father						
Conscientious compliance: Mother						
Sporty driving: Father						
Sporty driving: Mother						
Interpretation example: Respondents who were themselves owner of the primarily used vehicle were 79% more likely to drive at least 200 km per week with this vehicle than others.						

Tab. 79: Influence of vehicle availability, attitudes to vehicle availability, gender, personality and parental role model on vehicle use, measured by the odds difference (only significant values and only if greater than +25% or -20 %, corresponding to regression coefficients > 0.223 or < -0.223; calculation on the basis of Formula 5 in Section 2.2.2)

negligibly small as far as driving style is concerned). The status of vehicle owner, and even more so the status of principal user, is closely linked with intensive vehicle use: The principal user of a vehicle is almost five times more likely to drive at least 200 kilometres or for more than four hours compared to a driver who is not principal vehicle user.[63] Independently of this, owner status also correlates with vehicle use. The likelihood of driving at least 200 kilometres per week is 79% greater for owners than for non-owners (all other factors remaining constant; as safeguarded

[63] A reverse causality will play an important role here: A person who makes intensive use of a vehicle limits the opportunities for other members of the household to use that vehicle and must thus naturally be described as the principal user.

by the statistical method of multiple regression). The owner of a vehicle also drives more often alone and less often with two or more passengers.

Conclusion

The driving style young drivers attribute to themselves is dependent not only on gender, but also on general personality traits such as risk-taking propensity and conscientiousness, as well as on overall attitudes to driving and to a mentionable extent on the driving style of their parents.

The intensity and type of vehicle use, on the other hand, is far less dependent on these factors. In this context, it is much more important whether young drivers are themselves owner or at least principal user of their vehicle.

6 Summative evaluation on the basis of traffic offences

The summative evaluation is based on two components: A questionnaire study that relates self-reported driving behaviour to other information gathered by the survey, and a much broader replication study based on data records retrieved from the Central Register of Traffic Offenders (VZR).

6.1 Results on self-reported traffic offences (questionnaire study)

The survey analysed self-reported accidents and traffic offences which exceeded a previously described significance threshold (accident involvement, irrespective of fault, with damage exceeding €1,200 or injury to persons or recording of the accident by the police; traffic offences penalised with a fine of more than €25). Tab. 77 summarises the cases covered in this analysis.

More than 18,000 persons took part in the survey and together reported on more than 18,000 years of driving experience and almost 150 million kilometres driven. Together, they reported 1,372 significant traffic offences and 1,852 cases of involvement in significant traffic accidents (Tab. 81).

Compared to the Kk group, the rate of significant accident involvement in the Ek group was 19% lower per 1,000 drivers and year, and even 23% lower per million kilometres driven (Tab. 82; see also Fig. 20 and Fig. 21).

The differences in the rates of significant traffic offences are only marginally lower: In the Ek group, the figure per 1,000 drivers and year is 18% lower, and that per million kilometres driven 22% lower than in the Kk group.

Sample size	N = 18,762
Data source	Online questionnaires
Analysis groups	Ek group (8,785) and Kk group (9,977)
Analysis period	Analysis of data from all returned questionnaires[64]

Tab. 80: Analysis conditions and number of cases

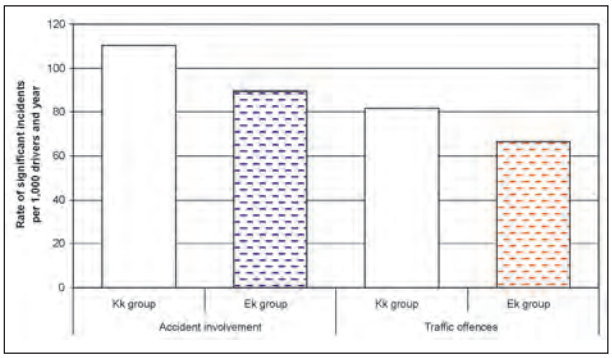

Fig. 20: Rates of significant accident involvement and traffic offences in the analysis groups per 1,000 drivers and year

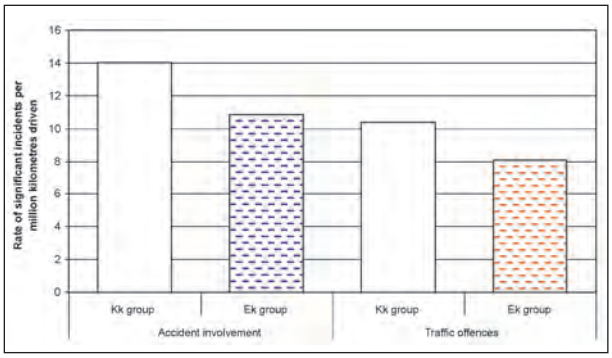

Fig. 21: Rates of significant accident involvement and traffic offences in the analysis groups per million kilometres driven

64 Unless expressly mentioned otherwise, the analyses in this section of the report also include the data of survey participants who dropped out after completing the first or intermediate questionnaire. In such cases, the period under observation commences with the start of solo driving and ends with the date of the last completed questionnaire.

	Ek group	Kk group
Number of survey participants	8,785	9,977
Total number of years under observation	8,855	9,589
Mean observation period per person (in months)	12.1	11.5
Total kilometres driven (in millions)	72.84	75.33
Mean kilometres driven per person and year	8,200	7,900
Reported cases of significant accident involvement	792	1,060
Reported cases of significant traffic offences	590	782

Tab. 81: Numbers of survey participants and reported significant accidents and traffic offences by analysis group

Statistical variable	Ek group	Kk group	Difference between Ek and Kk
Rate of accident involvement per 1,000 drivers and year	89.4	110.5	-19%
Rate of traffic offences per 1,000 drivers and year	66.6	81.6	-18%
Rate of accident involvement per million kilometres driven	10.9	14.1	-23%
Rate of traffic offencesper million kilometres driven	8.1	10.4	-22%

Tab. 82: Rates of reported significant accident involvement and traffic offences in the analysis groups per 1,000 drivers and year and per million kilometres driven

Conclusion

The expected effect of the AD17 model is reflected both in accident involvement and traffic offences. These indicators are lower for the group of former AD17 drivers than for novice drivers who obtained their driving licence in the conventional manner both in a period-based and a kilometre-based comparison. The reduction achieved ranged between 18 and 23 per cent.

6.2 Critical methodical evaluation of the results

The objective of the discussion in the following section is a critical methodical evaluation of results to date regarding the effectiveness of the AD17 model, as obtained on the basis of a survey of self-reported driving behaviour.

6.2.1 Are the observed differences between AD17 drivers and novice drivers who obtained a driving licence in the conventional manner statistically significant?

The hypothesis to be tested is the statistically unidirectional alternative hypothesis (see Section 2.2.1) that the rates of accident involvement and traffic offences among AD17 drivers are lower than for drivers who obtained their driving licence in the conventional manner.

For period-based comparisons, the duration of the individual observation period in years is incorporated into the Poisson regression as a covariate. The number of kilometres driven during the individual observation period is used accordingly for the kilometre-based evaluation. Significance testing with Poisson regressions produces four findings which describe differences between AD17 drivers and novice drivers who obtained a driving licence in the conventional manner, namely differences in the rates of self-reported accident involvement and traffic offences by both period of driving and kilometres driven.

The table (Tab. 83) shows the regression coefficients together with their standard errors. These values are then used to calculate the Z scores and the upper and lower limits of the so-called confidence intervals, which denote the ranges in which the “true” values , i.e. values unaffected by sampling errors, lie with a certainty of 95 per cent. The range of the confidence interval provides an indication of the degree of random error that affects the estimates identified by the analysis. With the aid of Formula 9 in Section 2.2.2, relative risk ratios can also be calculated from the regression coefficients (see bottom three rows of Tab. 83). The relative risk ratio of 0.809, for example, means that the period-related rate of accident involvement of AD17 drivers is only 80.9% of the comparable rate for novice drivers who obtained their driving licence in the conventional manner. In other words, accident involvement is

	Comparison of groups in respect of			
	period-based rates in respect of		kilometre-based rates in respect of	
	accidents	offences	accidents	offences
Coefficient: Estimate	-0.212	-0.202	-0.258	-0.248
Standard error	0.047	0.055	0.047	0.055
Z score	-4.511#	-3.707#	-5.491#	-4.551#
95% confidence interval: Upper limit	-0.120	-0.095	-0.166	-0.141
Lower limit	-0.304	-0.309	-0.350	-0.355
Relative risk*: Estimate	0.809	0.817	0.773	0.780
Relative risk*: Upper limit	0.887	0.909	0.847	0.868
Lower limit	0.738	0.734	0.705	0.701

* = Ratios of accident involvement and traffic offence rates between AD17 drivers and drivers with driving licences obtained in the conventional manner (see Formula 9 in Section 2.2.2);
# = $p < 0.001$ (highly significant)

Tab. 83: Results of Poisson regression analyses (comparison of AD17 drivers and drivers with driving licences obtained in the conventional manner)

reduced by 19.1% in the AD17 group (the complement to 100%). With the confidence interval relating to a range from 11.3% to 26.2%, this value is subject to considerable uncertainty. Despite this uncertainty regarding the precise extent of the reduction, however, there is no doubt over the reduction as such, because the Z scores point to a very high significance. The probability for the so-called “null hypothesis” is less than 0.1% for all four analyses.

The null hypothesis, namely that there are no differences between the groups (or that the AD17 group performs even less well than the group of novice drivers holding conventional driving licences), can therefore be rejected with the required probability of error of less than one per cent (Section 2.2.3). The alternative hypothesis that the AD17 group performs better, on the other hand, can be accepted.

Conclusion

Novice drivers who have participated in the AD17 model are involved in fewer accidents and commit fewer traffic offences during their first year of solo driving than those who obtain their driving licence in the conventional manner. The difference is statistically significant, not only with reference to accident involvement, but also in respect of traffic offences exceeding a certain significance threshold[65], in both the period-based and kilometre-based comparisons.

6.2.2 Are the Ek and Kk analysis groups strictly comparable?

This question addresses the uncertainty as to whether the different participant groups are really comparable, so that the observed differences can be clearly attributed to participation in the AD17 model and are not a result of pre-existing differences between groups.

The preliminary analysis findings (Section 4.5) indicated that distortions in the Ek and Kk groups, insofar as they exist at all, were only minor, suggesting that the samples can be considered representative for the federal states participating in the AD17 model[66]. The groups were of the same mean age during the period of their observation, as in both cases observation began with the commencement of solo driving after the participant's 18th birthday[67], and furthermore during the same calendar period. This means that they were subject to the same traffic conditions and the same seasonal influences. All seasons of the year were covered.

The parallel observation periods also ensure that changes in relevant legislation during the given period, for example the introduction of a zero alcohol limit for novice drivers[68], do not affect the

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65 Accident involvement, irrespective of fault, with damage exceeding €1,200 or injury to persons or recording of the accident by the police; traffic offences penalised with a fine of more than €25

66 At the time of sampling in mid-2007, the following federal states had been participating in the model for at least 12 months: Bavaria, Berlin, Brandenburg, Bremen, Hamburg, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatinate, Saarland, Saxony, Schleswig-Holstein.

67 As a number of the early beginners obtaining a driving licence in the conventional manner do not receive their licence until several weeks after their 18th birthday, they are slightly older during the observation period than the former AD17 drivers, for whom solo driving usually begins immediately on their 18th birthday. This age difference, however, is on average only 4.1 weeks, and is in any case a conservative effect in the sense of the present analysis, i.e. it makes it more difficult to prove the effectiveness of the AD17 model (because older drivers are on average involved less often in traffic offences and accidents).

68 § 24c German Road Traffic Act (StVG), in force since 01.08.2007

comparability of the results. At the same time, they also guarantee that any general trends in accident figures are similarly unable to falsify the outcome.

The fact that the number of participants and the mean duration of observation differ slightly between the two groups is taken into full account by the chosen methodology, as it produces two rate-based measures for comparison: The number of relevant incidents (accidents, traffic offences) per 1,000 persons and year.

Conclusion

The design of the analysis ensures that the analysis groups, and likewise the analysis conditions with regard to a series of applicable criteria, are strictly comparable.

6.2.3 Do any "external" variables bias the results?

Another potential objection is that the Ek and Kk groups may differ in other respects, besides the model by which they obtained their driving licence, and that these factors could themselves have a risk-reducing effect. Traffic research has identified female gender and a higher level of school education as such protective factors. The objection refers to "Hypothetical effect 2" (Section 1.2), namely differentiation of the novice drivers into high and low risks. Is it possible that the AD17 model attracts more female drivers and persons with a higher level of school education[69], and that this group displays a lower risk merely by virtue of these, and possibly, further risk-reducing factors, rather than due to any positive influence of the AD17 model?

It is scarcely possible to conclusively invalidate objections of this kind unless all potential risk-reducing factors are known and taken into account. On the other hand, objections can only refer to those factors which are proven to have a risk-reducing effect and furthermore occur more frequently in the Ek group than in the Kk group. It is to be considered in the following, whether or not these conditions are met.

The preliminary analyses (Section 4.5) revealed a tendency for there to be more female drivers in the Ek group than in the Kk group, likewise more residents of rural areas and more persons who had obtained or were preparing for at least an advanced school-leaving certificate (in the following summarised as persons with a higher education attainment level). In addition, a difference was found between the groups with regard to the driving behaviour of a parental role model: AD17 drivers replied slightly more frequently that their parents abided strictly by road traffic rules[70]. This could be a further risk-reducing factor.

In this context, it is expedient not only to investigate the possibility of the existence of latent risk-reducing factors alongside the protective effect of accompanied driving, which may facilitate a spurious correlation between the AD17 model and a reduced frequency of accident involvement or traffic offences. Attention should also be paid to the opposite case: An external variable with risk-enhancing effect, for example the somewhat greater vehicle availability in the AD17 group[71], may lead to underestimation of the causal influence of the AD17 model on road safety. After all, only those licence holders with actual opportunities to drive are able to commit traffic offences or be involved in accidents. If AD17 drivers have more frequent opportunities for accident involvement, this may overlay the possible accident-reducing influence of the AD17 model.

To adequately estimate the degree of causal correlation between the AD17 model and traffic behaviour, it is thus necessary to take into account all "external variables" which could overlay and neutralise any causal effects. Proof of whether or not the specified factors display the expected risk-reducing or risk-enhancing correlations with accidents and traffic offences is obtained by way of regression calculations. The results are shown in Tab. 84.

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69 As already suggested by data in GREGERSEN (1997, p. 31, Table 10)

70 A positive parental role model is assumed for the purposes of the following analyses if the survey participant confirmed conscientious driving behaviour on the part of both parents, insofar as data were provided (survey question: "My father/mother is very correct in abiding by road traffic rules"; this statement is "true" or "absolutely true"). Approx. 45% of novice drivers gave such a positive assessment of their parents.

71 Unlimited vehicle availability over the period of observation is assumed where the participant replies unanimously in all questionnaires completed that he or she is the owner of the vehicle used or at least its sole user (applicable in 37% of cases).

Characteristics	Ratios of accident involvement and traffic offences compared to the relevant reference group	
	Accident involvement per 1,000 drivers and year	Traffic offences per 1,000 drivers and year
Gender: Female (versus male)	0.78 ***	0.50 ***
Educational attainment: Advanced school certificate (versus lower)	0.91 n.s.	1.00 n.s.
Place of residence: Rural areas (versus others)	1.02 n.s.	0.88 *
Parental role model: Positive (versus negative)	1.00 n.s.	0.98 n.s.
Vehicle availability: Unlimited (versus limited)	1.95 ***	2.38 ***
Combination negative parental role model / lower educational attainment (versus others)	1.18 n.s.	1.31 *
Combination higher educational attainment / limited vehicle availability (versus others)	0.68 ***	0.59 ***
Goodness of fit of the regression model: Likelihood ratio (chi-squared)	p = 0.372	p = 0.196
Legend: n.s. = Difference to parity (1.0) not significant; * = statistically significant ($p \leq 0.05$); ** = statistically very significant ($p \leq 0.01$); *** = statistically highly significant ($p \leq 0.001$) Interpretation example: The ratio of the accident involvement of female novice drivers compared to their male counterparts is 0.78 This means that the accident risk for female drivers is lower by 22%.		

Tab. 84: Relative risk of accident involvement and traffic offences as dependent on selected external factors (period-based comparison)

Characteristics	Ratios of accident involvement and traffic offences compared to the relevant reference group	
	Accident involvement per 1,000 drivers and year	Traffic offences per 1,000 drivers and year
Gender: Female (versus male)	0.78 ***	0.50 ***
Educational attainment: Advanced school certificate (versus lower)	0.92 n.s.	1.02 n.s.
Place of residence: Rural areas (versus others)	1.03 n.s.	0.88 n.s.
Parental role model: Positive (versus negative)	1.01 n.s.	0.99 n.s.
Vehicle availability: Unlimited (versus limited)	1.97 ***	2.40 ***
Combination negative parental role model / lower educational attainment (versus others)	1.18 n.s.	1.32 *
Combination higher educational attainment / limited vehicle availability (versus others)	0.68 ***	0.59 ***
Driving licence model: AD17 (versus conventional model)	0.83 ***	0.85 **
Goodness of fit of the regression model: Likelihood ratio (chi-squared)	p = 0.441	p = 0.437
Legend: see Tab. 84 Interpretation example: The ratio of the accident involvement of AD17 drivers compared to those obtaining a driving licence in the conventional manner is 0.83. This means that the accident risk for AD17 drivers is lower by 17%.		

Tab. 85: Influence of the driving licence model on the rates of accident involvement and traffic offences, taking into account further factors (period-based comparison)

Whereas the factors educational attainment, place of residence[72] and parental role model – contrary to expectations – are shown to have no or only a minor influence on the rate of novice driver accident involvement and traffic offences, the factor gender is highly significant: Female novice drivers had a 22% lower accident rate than male novice drivers, and even a 50% lower frequency of traffic offences. As expected, higher vehicle availability increased the rates of accident involvement and traffic offences. Alongside vehicle availability per se, its combination with educational attainment is also relevant with respect to driving behaviour: Where higher educational attainment coincided with limited vehicle availability, the rates of both accident involvement and traffic offences were reduced significantly. The effect of the combination of these two factors was indeed greater than the sum of their separate effects (such multiplication effects are known in statistical analysis as interaction effects).

The analysis shows, therefore, that at least the slightly higher proportion of female drivers in the Ek group contributed to the positive impact of the AD17 model. This means that the objection of a certain bias in the current results must be taken seriously. The highly significant interaction between vehicle availability and educational attainment, on the other hand, is not of critical importance, as there was no difference between the two analysis groups in terms of this specific combination of factors, namely limited vehicle availability and higher educational attainment. At the same time, the analysis points to the considerable influence of the factor vehicle availability, which could well mask any strong causal effects if it is not taken into account explicitly.

Period-based comparison

In the following, regression analysis is used to verify whether the differences in accident involvement and traffic offences between the two analysis groups remain valid when the influences determined in Tab. 84 are taken into account. The following questions are of particular interest: Could the differences between the analysis groups presented in Tab. 82 possibly be explained by the slight difference in gender composition only? Does the slight difference in vehicle availability between the groups mask any strong causal effect?

These questions are addressed by the period-based comparison in Tab. 85. The sole objective here is to ascertain whether and to what extent the originally found impact of the AD17 model remains unchanged when the potentially distorting influence of “external variables” is taken into account. The highlighted row at the bottom of the table shows a significant reduction in accident involvement by 17% (originally 19%; see Tab. 82) for the Ek group compared to the Kk group, and a reduction of 15% (originally 18%) for traffic offences.

The AD17 model has apparently resulted in a slight internal risk differentiation in the sense of the effect described in Section 1.2, both to the advantage of the AD17 group (more female novice drivers) and to its disadvantage (more novice drivers with unlimited vehicle availability). The two opposing effects do not neutralise each other completely, however, with the result that the initial “gross differences” found between the groups are reduced by two to three percentage points when “external variables” are taken into account.

The remaining road safety gain from the AD17 model, namely a 15 to 17% reduction in accident involvement and traffic offences, can thus be attributed to the specific influence of the “AD17 experience”, assuming that no further external variables with risk-reducing or risk-enhancing effect are identified (see below).

The following graphs (Fig. 22 and Fig. 23) illustrate the differences between the analysis groups if only

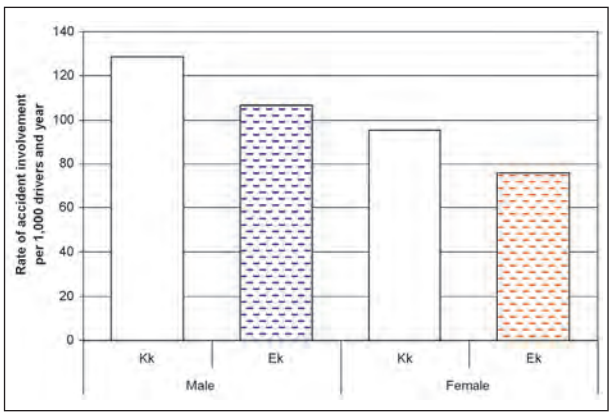

Fig. 22: Rate of accident involvement per 1,000 novice drivers and year in the first year of solo driving, differentiated by analysis group (Ek and Kk) and gender

[72] An evaluation on the basis of place of residence (as opposed to the usual reference to the place of accidents) was recently presented by HOLZ-RAU & SCHEINER (2009). According to their results, town-dwellers face a slightly greater risk of accidents involving minor injury than the residents of rural areas, but a considerably reduced risk of a traffic accident resulting in serious or fatal injuries.

the risk-reducing factor gender is taken into account. Subsequently, a further pair of graphs demonstrates the considerable risk-enhancing influence of vehicle availability on accident involvement and traffic offences (Fig. 24 and Fig. 25).

How great, however, is the influence attributable to the further differences which were determined between the Ek and Kk groups in the course of the preliminary analysis (Section 4.5)?

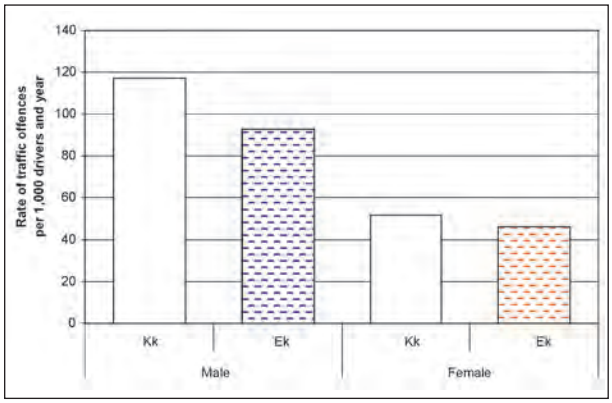

Fig. 23: Rate of traffic offences per 1,000 novice drivers and year in the first year of solo driving, differentiated by analysis group (Ek and Kk) and gender

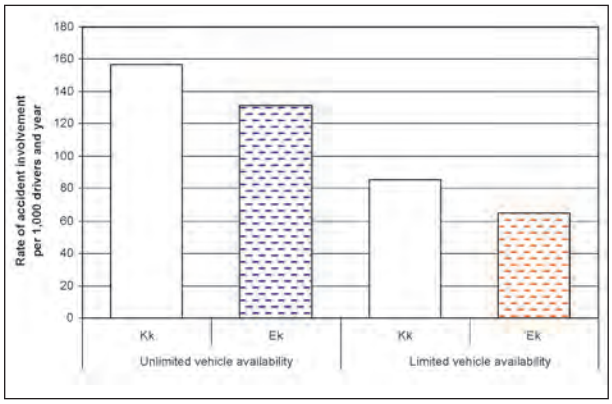

Fig. 24: Rate of accident involvement per 1,000 novice drivers and year in the first year of solo driving, differentiated by analysis group (Ek and Kk) and vehicle availability

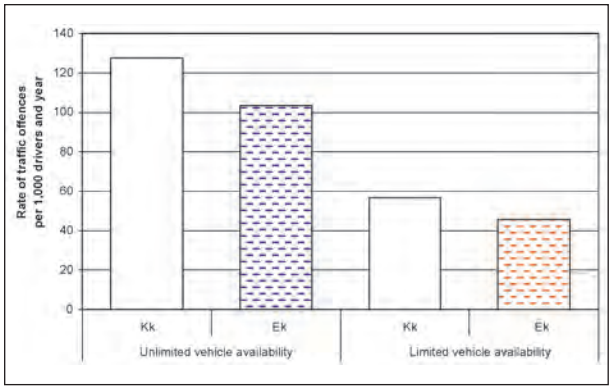

Fig. 25: Rate of traffic offences per 1,000 novice drivers and year in the first year of solo driving, differentiated by analysis group (Ek and Kk) and vehicle availability

A series of further minor differences is such that their effects on accident involvement and traffic offences (insofar as they become manifest at all) would tend to diminish the positive impact of the AD17 model. Consequently, such differences are irrelevant with regard to the objection of a falsely positive AD17 effect: AD17 drivers tend to report less prior practice with other vehicles, emphasise more frequently the importance of high levels of mobility, mention more frequently the availability of several vehicles in their household and the availability of a vehicle with an engine power of more than 50 kW, and report more frequently a weekly distance driven of more than 200 km and a driving time of more than four hours. All these differences imply an increased risk of accident involvement or traffic offences for the AD17 group and are therefore incongruent with the argument of a spurious correlation. It is rather the case that, as risk-enhancing factors, they support the notion that any AD17 effect may be underestimated.[73] Furthermore, practically all these factors contribute to the variable “annual distance driven”, which is considered further in the following as a risk-enhancing factor.

Two of the important differences revealed by the preliminary analysis, however, could still be relevant in connection with the reduced accident involvement and traffic offences among AD17 drivers: It is less often the case that they use either older vehicles or vehicles which are in poor technical condition. These circumstances could have facilitated the Ek group’s lower accident involvement. To investigate this hypothesis, the responses of the two analysis groups with regard to the nature of any accident involvement were scrutinised more closely. Of the 1,335 cases of accident involvement reported by the Kk group, 10 instances were attributed to “technical defects or maintenance deficits” (0.7%); among the 1,036 cases of accident involvement reported by the Ek group, this cause was mentioned 9 times (0.9%). Technical causes thus played only a very minor role, and there was practically no difference

[73] Given the limited sample sizes, it is not possible to incorporate all these factors into a regression analysis, to separate their individual influence and to retain the “pure” AD17 effect: The frequency would in this case contain empty cells, which are not permissible for such calculations.

between the two groups. The better condition of the vehicles used by the Ek group therefore cannot serve to explain their lower accident rate.

Kilometre-based comparison

Would the results be any different if the rates of accident involvement and traffic offences were to be compared on the basis of kilometres driven?

The survey data show that the annual distances driven by AD17 participants were on average four per cent higher than those of novice drivers not taking part in the AD17 model (see Tab. 81). Increased exposure to traffic can hardly explain a reduced risk of accident involvement and traffic offences. A kilometre-based evaluation of driving behaviour is thus unlikely to call the effectiveness of the AD17 model into question. Nevertheless, this objection is still investigated in the following, because distance driven plays a role as a risk-enhancing factor and could lead to underestimation of the causal effect of AD17 participation.

Tab. 86 shows the results of Poisson regression analyses of kilometre-based accident involvement and traffic offences. The figures firstly indicate (see the highlighted row at the bottom of the table), that the kilometre-based comparison, which takes into account the same control variables, actually places greater emphasis on the AD17 effect, now showing a reduction in the accident rate by 22% (previously 17%) and a reduction in traffic offences by 20% (previously 15%).

Secondly, as expected, it becomes clear that kilometre-based accident involvement and traffic offence rates dilute the influence of vehicle availability, and similarly the influence of gender. The (greater) vehicle availability and the (male) gender of the drivers play no significant role for the numbers of accidents per million kilometres. For the numbers of traffic offences per million kilometres, however, they are still of considerable, albeit now slightly reduced importance[74] (see Fig. 26 and Fig. 27).

74 The factor of vehicle availability, as defined here (see footnote 71), comprises two essential elements, both of which are related to the absence of a social corrective: On the one hand, a high degree of availability means that the

Characteristics	Ratios of accident involvement and traffic offences compared to the relevant reference group			
	Accident involvement		Traffic offences	
	per million kilometres	per year (cf. Tab. 85)	per million kilometres	per year (cf. Tab. 85)
Gender: Female (versus male)	0.98 n.s.	0.78 ***	0.63 ***	0.50 ***
Educational attainment: Advanced school certificate (versus lower)	1.17 n.s.	0.92 n.s.	1.30 **	1.02 n.s.
Place of residence: Rural areas (versus others)	0.95 n.s.	1.03 n.s.	0.81 **	0.88 n.s.
Parental role model: Positive (versus negative)	1.00 n.s.	1.01 n.s.	0.97 n.s.	0.99 n.s.
Vehicle availability: Unlimited (versus limited)	1.01 n.s.	1.97 ***	1.24 **	2.40 ***
Combination negative parental role model/ lower educational attainment (versus others)	1.17 n.s.	1.18 n.s.	1.31 *	1.32 *
Combination higher educational attainment/ limited vehicle availability (versus others)	0.92 n.s.	0.68 ***	0.79 *	0.59 ***
Driving licence model: AD17 (versus conventional model)	0.78 ***	0.83 ***	0.80 ***	0.85 **
Goodness of fit of the regression model: Likelihood ratio (chi-squared)	p = 0.642		p = 0.636	
Legend: n.s. = Difference to parity (1.0) not significant; * = statistically significant ($p \leq 0.05$); ** = statistically very significant ($p \leq 0.01$); *** = statistically highly significant ($p \leq 0.001$)				

Tab. 86: Influence of the driving licence model on the kilometre-based relative risk of accident involvement and traffic offences taking into account further factors and compared to the period-based calculation in Tab. 85

The introduction of the AD17 model thus resulted in slight internal differentiation within the group of "young novice drivers" in the sense of "Hypothetical effect 2" (see Section 1.2): The group of AD17 participants counts more female drivers and more novice drivers with greater vehicle availability; the average distance driven per year is also somewhat higher. The first factor has a risk-reducing effect, whereas the second and third are rather risk-enhancing. Overall, the contrary effects on the rates of accident involvement and traffic offences arising from the differentiation tendencies more or less cancel each other out.

This mutual compensation, however, is not perfect: When the risk-reducing factor of an increased proportion of female drivers in the AD17 group is taken into account together with the risk-enhancing factor of greater vehicle availability, the reductions in accidents and traffic offences are two to three per cent lower, but nevertheless statistically significant at 15 to 17%. Additional inclusion of the risk-enhancing factor of a slightly greater distance driven among AD17 drivers leads to a more evident reduction in accidents and traffic offences by five per cent; the reduction is then between 20 and 22%.

Despite a certain internal differentiation, the initially formulated "Hypothetical effect 3" (see Section 1.2) remains valid, namely that a causal correlation exists between participation in the AD17 model and a later reduced risk of accidents and traffic offences.

The Swedish study of GREGERSEN et al. (2000) can be used for comparison. From the methodical point of view, the most comparable figures are the accident reduction rates for previously accompanied drivers and those who underwent conventional driver training, after controlling for confounding variables[75]: On the basis of the distance driven, GREGERSEN et al. report a reduction by 24% (23.9% according to Table 8, p. 33), while the present study identified a corresponding reduction by 22% on the basis of survey data (Tab. 86) – remarkably similar figures.

Conclusion

The positive effect of the AD17 model cannot simply be attributed to an internal differentiation into high and low risks, as factors with risk-reducing and risk-enhancing effects for road safety within the AD17 group cancel each other out to a large degree. Even if such factors are taken into account, AD17 participants achieve significantly better results with regard to accident involvement and traffic offences.

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74 driver feels less restricted in his/her impulses to use the vehicle and probably drives more kilometres as a result. Secondly, as the driver is usually also the owner of the vehicle, and may as such be less obliged to account to others for driving behaviour (e.g. notices of fines are received directly), he/she may be less hesitant to risk traffic offences. The kilometre-based comparison neutralises the first contributory element of vehicle availability, namely the amount of driving done. The accepted risk of convictions for traffic offences, on the other hand, remains unaffected from this new perspective. The remaining effect of vehicle availability shown in Tab. 86 presumably reflects this second component.

75 GREGERSEN et al. specify the marginally different level of educational attainment, a marginal age difference at the start of solo driving and the long-term downward trend in accident figures.

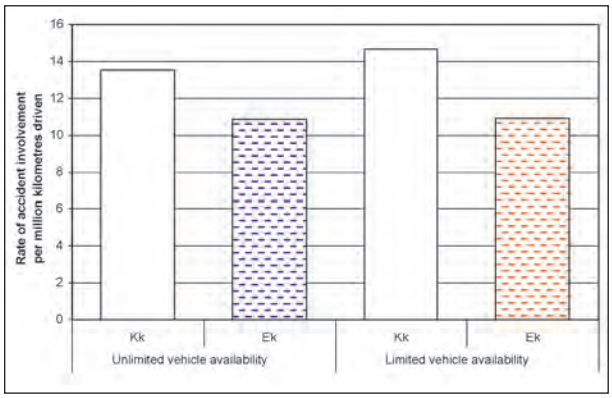

Fig. 26: Rate of accident involvement per million kilometres driven in the first year of solo driving, differentiated by analysis group (Ek and Kk) and vehicle availability

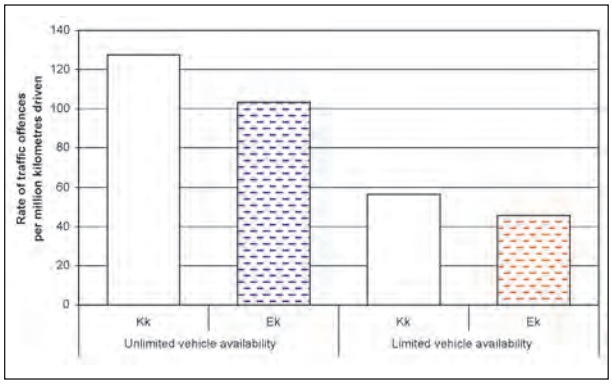

Fig. 27: Rate of traffic offences per million kilometres driven in the first year of solo driving, differentiated by analysis group (Ek and Kk) and vehicle availability

6.2.4 Are the results distorted by the data of premature drop-outs?

The above analyses were based on the responses of all survey participants, including those who terminated their cooperation prematurely after returning the initial or intermediate questionnaire. Would the exclusion of these drop-outs have produced more valid results, despite the correspondingly diminished sample size?

To answer this question, the analysis for Tab. 85 was repeated without the data of respondents who terminated their survey participation prematurely. The analysis conditions and adjusted numbers of cases are shown in Tab. 87.

Sample size	N = 12,532
Data source	Online questionnaires
Analysis groups	Ek group (6,021) and Kk group (6,511), including only respondents who completed the final questionnaire
Analysis period	Evaluation of the data of all returned questionnaires

Tab. 87: Analysis conditions and number of cases

The results in Tab. 88 (grey columns) display only marginal changes compared to those originally reported in Tab. 85, and furthermore only changes which do not challenge the previously drawn conclusions. It is in particular apparent that the inclusion of drop-out participants in the analyses of Section 6.2.3 does not lead to an overestimation of the AD17 effects – rather the opposite is the case (see the highlighted row at the bottom of the table).

Conclusion

The exclusion of survey participants who terminated their cooperation prematurely would have practically no effect on the results of the regression analyses. The validity of statements on the effectiveness of the AD17 model is not diminished.

Characteristics	Ratios of accident involvement and traffic offences compared to the relevant reference group			
	Accident involvement per 1,000 drivers and year		Traffic offences per 1,000 drivers and year	
	Adjusted sample	Values in Tab. 85	Adjusted sample	Values in Tab. 85
Gender: Female (versus male)	0.79 ***	0.78 ***	0.51 ***	0.50 ***
Educational attainment: Advanced school certificate (versus lower)	0.93 n.s.	0.92 n.s.	0.92 n.s.	1.02 n.s.
Place of residence: Rural areas (versus others)	1.06 n.s.	1.03 n.s.	0.92 n.s.	0.88 n.s.
Parental role model: Positive (versus negative)	0.98 n.s.	1.01 n.s.	0.98 n.s.	0.99 n.s.
Vehicle availability: Unlimited (versus limited)	2.01 ***	1.97 ***	2.30 ***	2.40 ***
Combination negative parental role model/ lower educational attainment (versus others)	1.09 n.s.	1.18 n.s.	1.32 *	1.32 *
Combination higher educational attainment/limited vehicle availability (versus others)	0.71 **	0.68 ***	0.66 **	0.59 ***
Driving licence model: AD17 (versus conventional model)	0.83 ***	0.83 ***	0.83 **	0.85 **
Goodness of fit of the regression model: Likelihood ratio (chi-squared)	p = 0.586		p = 0.393	

Legend: n.s. = Difference to parity (1.0) not significant; * = statistically significant ($p \le 0.05$);
** = statistically very significant ($p \le 0.01$); *** = statistically highly significant ($p \le 0.001$)

Interpretation example (row "Gender"): The ratio of the accident involvement of female novice drivers compared to their male counterparts is 0.79. This means that the accident risk for female drivers is lower by 21% per 1,000 drivers and year.

Tab. 88: Influence of the driving licence model on the rates of accident involvement and traffic offences per 1,000 drivers and year, taking into account further factors and excluding those respondents who terminated their survey participation before completing the final questionnaire (compared to the corresponding values of the unadjusted sample from Tab. 85)

6.2.5 Does the model possibly achieve a merely temporary effect?

Another conceivable challenge to the evaluation approach relates to the possibility that, on account of the much longer period of parental accompaniment in the Ek group, the positive effects also last somewhat longer[76] than the otherwise equally positive effects of conventional driver training. It is therefore important to check whether the identified AD17 effect occurs exclusively or predominantly at the beginning of solo driving and subsequently fades rapidly.

To investigate this question, self-reported accidents and traffic offences of all respondents who took part in the whole survey and completed the final questionnaire were assigned to an early and a later analysis period: Firstly the period up to completion of the initial questionnaire (on average six to seven months after the start of solo driving), and secondly the period between the initial and final questionnaires (on average approx. seven months). In the following – for sake of simplicity – these periods are described as the first half and second half of the observation period. The cases included in this sample are identical to those already specified in Tab. 87.

First of all, Poisson regression[77] was used to test whether the rates of accident involvement and traffic offences differed significantly between the two periods. This produced a very interesting result (see Tab. 89, second row from the bottom): While the rate of traffic accidents fell significantly by on average 19% between the first and second half of the observation period, the rate of traffic offences rose significantly by on average 29% between the two periods.[78] Although important for road safety research, this result is not central to the focus of this report and is thus not explored further in the current context.

The relevant question for the present analysis is solely whether or not the protective influence of the

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76 In the mind of the young driver, the persons previously accompanying their driving (parents) often continue to travel in the passenger seat for several weeks.

77 The factor “Place of residence” (urban/rural), which had not displayed particular significance in any of the previous regression analyses, was not included in the subsequent analyses, so as not to burden the sample size unnecessarily.

78 HANSJOSTEN & SCHADE (1997) report similar results for drivers with probationary driving licences. See also the results of CATCHPOLE (2005, p. 35, Fig. 19): In the first year of driving practice, the rates of rule violations with high and low accident risk are similarly divergent.

Characteristics	Ratios of accident involvement and traffic offences compared to the relevant reference group	
	Accident involvement per 1,000 drivers and year	Traffic offences per 1,000 drivers and year
Gender: Female (versus male)	0.79 ***	0.51 ***
Educational attainment: Advanced school certificate (versus lower)	0.93 n.s.	0.92 n.s.
Parental role model: Positive (versus negative)	0.98 n.s.	0.98 n.s.
Vehicle availability: Unlimited (versus limited)	2.01 ***	2.30 ***
Combination negative parental role model / lower educational attainment (versus others)	1.09 n.s.	1.32 *
Combination higher educational attainment / limited vehicle availability (versus others)	0.71 **	0.66 **
Driving licence model: AD17 (versus conventional model)	0.83 ***	0.83 **
Section of observation period: Second half (versus first half)	0.81 ***	1.29 ***
Goodness of fit of the regression model: Likelihood ratio (chi-squared)	p = 0.138	p = 0.707

Legend: n.s. = Difference to parity (1.0) not significant; * = statistically significant ($p \leq 0.05$);
** = statistically very significant ($p \leq 0.01$); *** = statistically highly significant ($p \leq 0.001$);
Interpretation example: The ratio of accident involvement during the second half of the observation period compared to the first half is 0.81. This means that the accident risk is reduced by 19%.

Tab. 89: Relative risk of accident involvement and traffic offences per 1,000 drivers and year as dependent on the section of the observation period, taking into account further factors

AD17 model decreases in the second half of the observation period. From a statistical point of view, this would be reflected as a significant interaction effect between driving licence model and section of the observation period in the Poisson regression. However, no such interaction was found for accident involvement or for traffic offences. In both cases, a regression model which comprises solely main effects and assumes interactions of zero only is shown to be fully compatible with the data (Pearson chi-square for the model "Traffic accidents" with 55 degrees of freedom: 63.3, p = 0.207; for the model "Traffic offences" with 55 degrees of freedom: 47.8, p = 0.744).

The rates of accident involvement and traffic offences (see Fig. 28 and Fig. 29) even suggest an (admittedly not significant) tendency in the opposite direction: The difference in the rates of accident involvement and traffic offences between the AD17 group and the control group appear to be even more distinctive in the second half of the observation period than in the first half.

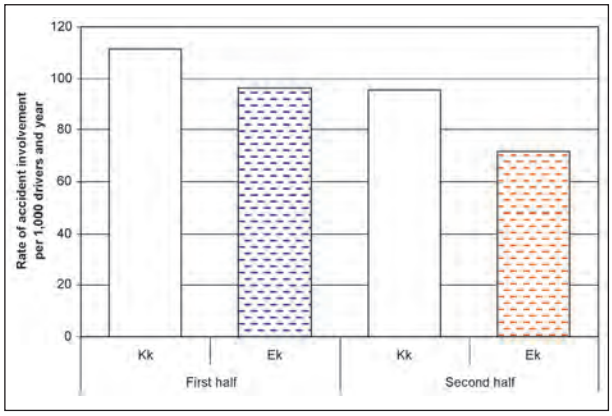

Fig. 28: Rate of self-reported accident involvement, differentiated by analysis group (Ek and Kk) and section of observation period

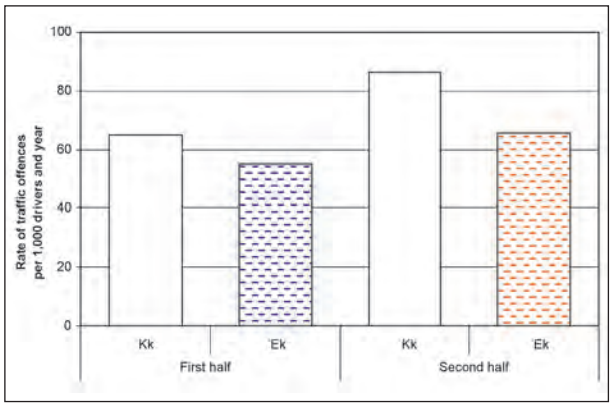

Fig. 29: Rate of self-reported traffic offences, differentiated by analysis group (Ek and Kk) and section of observation period

Conclusion

The aforementioned challenge of a possibly temporary effect is not supported by the data. The effect of the AD17 model instead appears to be preserved over the whole observation period covering the first approx. 14 months of solo driving (the question of how long this effect is maintained is the subject of a more detailed analysis on the basis of data from the Central Register of Traffic Offenders in Section 6.3.6).

This confirms the experience gained with accompanied driving in other countries, namely that the observed accident reduction is by no means limited to the first year of solo driving (GREGERSEN et al., 2000).

6.2.6 What evidence supports the assumption of a (causal) effect of the AD17 model?

Particularly sound evidence for the (causal) effect of a measure is often only to be obtained through verification of a so-called "dose-response relationship" and proof of the "specificity" of the effect.

For a dose-response relationship, a cause of the effect is postulated, i.e. an "agent", the intensity of which determines the extent of the effect. In the case of the AD17 model, the "agent" is practising driving whilst being accompanied by an adult driver. Where the extent of this practice tends to zero, it is no longer possible to expect a causal effect from the AD17 model. The driving practice can be measured by the duration of the accompanied driving phase in months; the more direct approach, however, would be to determine the distance driven while being accompanied in kilometres.

The specificity of an effect describes the degree to which a positive response to the measure of interest is witnessed exclusively or predominantly in precisely the aspect of behaviour for which the measure was developed. In the case of the AD17 model, the effect should be achieved in terms of overall driving safety and driving behaviour. A non-specific effect would give rise to doubt as to the underlying mechanism of the effect.

Dose-response relationship

To explore the dose-response relationship, the Ek group was analysed in more detail. The

Sample size	N = 6,021
Data source	Online questionnaires
Analysis group	All participants of the Ek group who completed a final questionnaire
Analysis period	Analysis of the data of all returned questionnaires

Tab. 90: Analysis conditions and number of cases

corresponding analysis conditions and the number of cases are given in Tab. 90.

The Ek group sample was divided firstly on the basis of the duration of the accompanied driving phase (up to 6 months[79], over 6 up to 10 months, over 10 up to 12 months), and secondly according to actual driving practice during this period (up to 500 km accompaniment, 501 to 1,000 km accompaniment, more than 1,000 km accompaniment).

The dose-response relationship here refers to the hypothesis that AD17 drivers who report a longer accompanied driving phase, and in particular those with more driving practice in terms of kilometres, will display lower rates of accident involvement.[80] Correspondingly, drivers with a less intensive accompanied driving phase should display higher rates of accident involvement and traffic offences.

To test this hypothesis, the intensity of the accompanied driving phase is included in the regression analyses as a predictor. Survey data on the length of the participants' accompanied driving phases in months and their driving practice during this period in kilometres are used for the purpose. Due to the significantly reduced sample size (the analysis includes only the Ek group and within that group only those respondents who also completed the final questionnaire), it is only possible to consider the most important control variable, namely gender, in the regression analysis. Otherwise, certain frequency cells would be empty.

One particular methodical difficulty stands in the way of the direct approach. Driving practice during the accompanied driving phase correlates positively with driving practice during the first year of solo driving: Evidence shows that those participants who record more kilometres driven during the accompanied driving phase will also drive more later on. This still applies if vehicle availability is taken into account. As greater exposure translates into a higher level of risk, a spurious correlation becomes manifest: Paradoxically, a more intensive accompanied driving phase is linked with a subsequently increased risk of accident involvement and traffic offences. It could thus be concluded that accompanied driving has a negative safety effect. The simple remedy for this methodical difficulty (namely the presence of a confound leading to a spurious correlation) is to relate the numbers of accidents and traffic offences to the kilometres driven, so that differences in individual driving practice no longer influence the results directly.

The results of the regression analyses are shown in Tab. 91 and Tab. 92. While less driving practice during the accompanied driving phase (see Tab. 91) leads to an increase in accident involvement and traffic offences, the duration of the accompanied driving phase (at least for a minimum duration of 4 months) shows no clear effect (see Tab. 92)[81]. Applying the defined significance threshold of 1.0 per cent for the present analyses – which, given the importance of the study, represents the just still acceptable probability of error – only one effect remains significant in the evaluation of the results: Driving practice of less than 500 kilometres during the accompanied driving phase can be linked to an increased rate of traffic offences per million kilometres. A dose-response relationship is therefore present for the rate of traffic offences, but not for the rate of accident involvement, despite a noticeable tendency.[82]

Further indication of a dose-response relationship is provided by the fading effect of the measure with

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79 Due to the selection criteria applied, there were very few cases of an accompanied driving phase of less than 4 months in the sample. This meant that no analysis of this group was possible, despite its particular interest in relation to the questions the present study aims to answer.

80 This is a so-called unidirectional hypothesis, which means that the statistical testing is also carried out unidirectionally.

81 In the evaluation of the AD17 model in Lower Saxony, STIENSMEIER-PELSTER (2007), by contrast, reports a significant correlation in the expected direction when two groups are formed, the first with a duration of accompanied driving of up to 6 months and the second with a duration of more than 6 months.

82 This analysis suffers in that the sample size is too small to permit the detection of particularly rare occurrences and particularly weak effects. If all reported accidents and traffic offences were to be considered, instead of only those exceeding the defined relevance threshold (see Section 2.1.3), the data set would be considerably larger (1,373 traffic offences instead of 425, and 784 traffic accidents instead of 590). This would raise the power of the statistical test. In fact, the influence of driving practice meets the defined minimum significance of 1 per cent for accidents under these more favourable conditions.

increasing time since participation (successful demonstration of this – otherwise regrettable – effect is already mentioned at this point in anticipation of Section 6.3.6 below).

Specificity

In the aforementioned analyses, trivial accidents and traffic offences were explicitly excluded. This approach was chosen for methodological reasons, so as not to leave decisions on which events and circumstances were to be considered worthy of reporting to the discretion of the survey respondent, and to ensure the application of common criteria for all responses received.

The analysis of trivial accidents and traffic offences[83] (Tab. 93) showed no significant differences between the Ek and Kk groups. This supports – alongside a possibly diminished validity

83 Accident involvement, irrespective of fault, with damage not exceeding €1,200, no injury to persons and no recording of the accident by the police; traffic offences penalised with a fine of less than €25

Characteristics	Ratios of accident involvement and traffic offences compared to the relevant reference group	
	Accident involvement per million kilometres	Traffic offences per million kilometres
Driving practice with accompaniment: up to 500 km (versus over 1,000 km)	1.21 *	1.47 ***
Driving practice with accompaniment: 500 to 1,000 km (versus over 1,000 km)	1.25 *	1.14 n.s.
Gender: Female (versus male)	0.93 n.s.	0.62 ***
Goodness of fit of the regression model: Likelihood ratio (chi-squared)	p = 0.528	p = 0.168
Legend: n.s. = Difference to parity (1.0) not significant; * = statistically significant ($p \leq 0.05$); ** = statistically very significant ($p \leq 0.01$); *** = statistically highly significant ($p \leq 0.001$)		

Tab. 91: Influence of driving practice during the accompanied driving phase on the kilometre-based rates of accident involvement and traffic offences, taking into account gender

Characteristics	Ratios of accident involvement and traffic offences compared to the relevant reference group	
	Accident involvement per million kilometres	Traffic offences per million kilometres
Duration of accompanied driving phase: 4 to 6 months (versus 10 to 12 months)	0.95 n.a.	1.03 n.s.
Duration of accompanied driving phase: 6 to 10 months (versus 10 to 12 months)	1.13 n.s.	0.86 n.a.
Gender: Female (versus male)	0.93 n.s.	0.64 ***
Goodness of fit of the regression model: Likelihood ratio (chi-squared)	p = 0.170	p = 0.847
Legend: n.s. = Difference to parity (1.0) not significant; * = statistically significant ($p \leq 0.05$); ** = statistically very significant ($p \leq 0.01$); *** = statistically highly significant ($p \leq 0.001$); n.a. = significance test not applicable, as unidirectional hypothesis to be rejected		

Tab. 92: Influence of the duration of the accompanied driving phase on the kilometre-based rates of accident involvement and traffic offences, taking into account gender

	Ek group	Kk group	Difference between Ek and Kk
Rate of trivial accident involvement* per 1,000 drivers and year	27.6	28.7	-4%
Rate of trivial traffic offences* per 1,000 drivers and year	134.2	133.6	±0%
* = see footnote 83			

Tab. 93: Rates of insignificant (trivial) accident involvement and traffic offences in the analysis groups

of data on trivial incidents – the assumption of a specific effect of the AD17 model, as there is no significant influence on trivial incidents and offences.

The following analysis investigates whether the AD17 effect becomes more distinct with increasing severity of the accident involvement or traffic offence. To this end, separate calculations[84] are performed for different significance thresholds.

Tab. 94 indeed shows that the risk-reducing effect of the AD17 model is more evident in connection with serious accidents and traffic offences. The model is particularly effective with regard to accidents and traffic offences above a higher relevance threshold, and less so or not at all with regard to minor incidents such as parking infringements or "bumps" during slow manoeuvring, e.g. in a car park. This specificity is a further point which supports a direct causal correlation between model and effect.

Conclusion

Several indicators support a causal effect of the AD17 model on driving safety in the sense of the initially formulated "Hypothetical effect 3". A dose-response relationship exists: The rates of accidents and traffic offences decrease with increasing driving practice, measured in kilometres, during the accompanied driving phase. The effect also fades with increasing time since accompanied driving. The results indicate the effect to be highly specific: The AD17 model remains practically ineffective with regard to accidents and traffic offences of minor relevance (trivial incidents), but exerts an ever stronger effect with increasing severity of the incidents. Serious accidents and traffic offences are reduced more significantly than trivial incidents by the AD17 model.

Indicator and significance threshold applied	Difference Ek versus Kk
Accident involvement:	
All reported accidents	-16%
Only accidents with injury to persons, damage exceeding €1,200 or recording by the police	-19%
Traffic offences:	
All reported traffic offences	- 6%
Only those penalised with fines over €15	-12%
Only those penalised with fines over €25	-18%
Only those penalised with fines over €40	-30%

Tab. 94: Rates of accident involvement and traffic offences per 1,000 drivers and year for different significance thresholds (the thresholds applied elsewhere in the present study are highlighted grey)

6.2.7 Is self-reported behaviour a sufficiently valid data source?

Objections are occasionally expressed against results based on self-reported behaviour, especially where they address "negative" behaviour or even failure.[85] It is claimed that this data source is insufficiently valid and conclusive for an evaluation with far-reaching (legal) consequences and must thus be supported with objective information.

In response to this challenge, the results obtained are supplemented by an evaluation of the data records held in the Central Register of Traffic Offenders (VZR) on the survey respondents. Tab. 95 summarises the applied analysis conditions and the number of cases considered.

Comparison of the number of persons reporting traffic offences penalised with a fine of €40 or more with the VZR data records suggests considerable "under-reporting": Per 100 female drivers with VZR data records, only 88 themselves report offences[86]; in the case of male drivers, this ratio is only 79 to 100. The difference between the Ek (83 self-reported offences per 100 VZR data records) and Kk groups (81 self-reported offences per 100 VZR data records) is very small, and also "conservative" in the context of the analysis; its effect in the evaluation of self-reported behaviour is actually to

Sample size	N = 18,749
Data sources	Online questionnaires and VZR data records
Analysis groups	Ek group (8,778) and Kk group (9,971)
Analysis period	Evaluation of the data of all returned questionnaires

Tab. 95: Analysis conditions and number of cases

84 These calculations are not regression analyses taking into account control variables, but instead direct calculations of the rate of accident involvement and traffic offences per 1,000 drivers and year using the same method applied in Section 6.1.

85 Relevant studies (e.g. recently STAUBACH & LÜKEN, 2009), however, do not support the assumption that the accident reports of involved persons are generally less useful.

86 Many persons reporting offences penalised with a fine of €40 or more did not also indicate the existence of VZR data records

Statistical variable	Ek group	Kk group	Relative difference between Ek and Kk
Number of VZR-recorded accidents	77	128	
Number of VZR-recorded traffic offences (including accidents)	291	429	
Rate of VZR-recorded accidents per 1,000 drivers and year	8.7	13.4	(-35%)
Rate VZR-recorded traffic offences per 1,000 drivers and year	32.9	44.8	-27%
Rate of VZR-recorded accidents per million kilometres	1.1	1.7	(-38%)
Rate VZR-recorded traffic offences per million kilometres	4.0	5.7	-30%

Tab. 96: Rates of VZR-recorded accident involvement and traffic offences per 1,000 drivers and year and per million kilometres driven for the analysis groups Ek and Kk (limitation: The relative accident rate differences in the last column are subject to considerable error due to the low frequency of occurrence and are for this reason enclosed in brackets)

Source	Accidents	Offences
Survey	Accident involvement, irrespective of fault, with damage exceeding €1, 200 or injury to persons or recording of the accident by the police	Offences penalised with a fine of more than €25
VZR	At-fault accident (without relevance threshold)	Offences penalised with a fine of more than €40

Tab. 97: Differences in meaning between the VZR and survey data with regard to the indicators "Accidents" and "Traffic offences"

the detriment of confirmation of the effectiveness hypothesis.

Some 43% of the male drivers and 44% of the female drivers with VZR data records did not report these offences. At the same time, 28% of the male drivers and 36% of the female drivers who reported traffic offences penalised with a fine of at least €40 have no VZR data record. These inconsistencies require reconsideration of the previously determined effects on the basis of the objective VZR data.

Tab. 96 presents basic statistics on VZR entries for the contacted analysis groups Ek and Kk during the relevant phase of solo driving. Contrary to expectations at the time when the analysis was planned, VZR-recorded accidents turned out to be extremely rare. The sample sizes were not planned to deal with such low numbers. This means that the calculated rates (and even more so the relative differences based on those results, see last column in Tab. 96) are subject to a considerable sampling error. Results presented in this section must therefore be interpreted with considerable caution, especially with regard to accidents.

To compare the results from objective VZR data with those from survey questionnaires, Poisson regressions were calculated (including the same predictors). The rates of accident involvement and traffic offences, however, were based on objective VZR data instead of the survey responses.

The result tables (Tab. 98 and Tab. 99) also show the corresponding self-reported rates from Tab. 86 for comparison. Proper interpretation, however, requires that differences in meaning between the VZR data records and the survey reports be taken into account, as this makes direct comparison of the results more difficult (see Tab. 97).

To enable comparisons of the results from the objective and subjective data sources, so-called confidence intervals must be calculated for the statistical parameters ("risk ratio"; the quotients of two rates). The 95% confidence interval indicates the range within which "true" values, i.e. values free of sampling error, lie with a certainty of 95 per cent. The limits of this range were calculated for all parameters in the two comparisons (Tab. 98 and Tab. 99). The tables show the corresponding intervals only for the factor "Driving licence model", as the factor of interest in the current context. The large confidence intervals reflect the unexpectedly low frequencies of occurrence and the correspondingly high sampling error already mentioned above.

The comparison of the effects identified for the driving licence model indicates that the 95% confidence interval calculated on the basis of VZR data encloses the effect calculated from the survey responses (example from Tab. 99: The confidence interval from 0.64 to 0.86 placed around the value 0.74 also includes the value 0.80). In these cases,

Characteristics	Ratios of accident involvement compared to the relevant reference group			
	Accidents per million kilometres		Accidents per 1,000 drivers and year	
	Objective VZR data	Survey response	Objective VZR data	Survey response
Gender: Female (versus male)	0.72 *	0.98 n.s.	0.57 ***	0.78 ***
Educational attainment: Advanced school certificate (versus lower)	0.73 n.s.	1.17 n.s.	0.58 *	0.92 n.s.
Place of residence: Rural areas (versus others)	1.10 n.s.	0.95 n.s.	1.19 n.s.	1.03 n.s.
Parental role model: Positive (versus negative)	1.02 n.s.	1.00 n.s.	1.04 n.s.	1.01 n.s.
Vehicle availability: Unlimited (versus limited)	0.83 n.s.	1.01 n.s.	1.61 *	1.97 ***
Combination negative parental role model/ lower educational attainment (versus others)	0.90 n.s.	1.17 n.s.	0.91 n.s.	1.18 n.s.
Combination higher educational attainment/ limited vehicle availability (versus others)	0.96 n.s.	0.92 n.s.	0.72 n.s.	0.68 ***
Driving licence model: AD17 (versus conventional model)	0.64 **	0.78 ***	0.69 **	0.83 ***
95% confidence interval	0.48 – 0.86		0.52 – 0.92	
Goodness of fit of the regression model: Likelihood ratio (chi-squared)	p = 0.111		p = 0.138	

Legend: n.s. = Difference to parity (1.0) not significant; * = statistically significant ($p \leq 0.05$); ** = statistically very significant ($p \leq 0.01$); *** = statistically highly significant ($p \leq 0.001$)

Interpretation example (row "Gender"): The ratio of VZR-recorded accidents per million kilometres among female novice drivers compared to their male counterparts is 0.72. This means that the accident risk for female drivers is lower by 28%.

Tab. 98: Comparison of the effects on accident involvement when using objective VZR data versus survey response (as taken from the two corresponding columns of Tab. 86)

the divergence between the two effect estimates can be attributed to sampling error, i.e. they are not significant. Verification of the effects on the basis of confidence intervals was performed for all the factors[87], without revealing any significant deviations.

The analysis thus produces several findings: The use of objective data instead of survey responses does not lead to fundamentally different conclusions. With only minor exceptions, all effects were reproduced. One of the effects which tended to emerge even more prominently from the objective data was that of accompanied driving. Gender also tends to have a greater effect when evaluated on the basis of objective VZR data.

The more prominent AD17 effect with VZR data is not only attributable to the objective nature of the data, however, but in part also to the higher "relevance threshold" compared to the survey questionnaire (cf. Tab. 97). In the case of the accident indicators, it must be remembered that the VZR data records comprise accidents where the drivers concerned carry a significant portion of the fault, whereas the survey queried only accident involvement, irrespective of fault. The VZR data thus possess greater specificity and relevance for the evaluation. The situation is similar with regard to traffic offences: The survey responses include fines from €25, the VZR data records only from €40. As described in Section 6.2.6, the effectiveness of the AD17 model emerges more clearly through indicators with a higher "relevance threshold" (fine of €40 instead of €25). The shift from an analysis

87 The method is a little more complicated than described here, as confidence intervals are calculated around both values and then tested for overlaps. The lack of significance is naturally only an indicator, but not proof that the deviations are not relevant.

Characteristics	Ratios of traffic offences compared to the relevant reference group			
	Traffic offences per million kilometres		Traffic offences per 1,000 drivers and year	
	Objective VZR data	Survey response	Objective VZR data	Survey response
Gender: Female (versus male)	0.47 ***	0.63 ***	0.38 ***	0.50 ***
Educational attainment: Advanced school certificate (versus lower)	0.91 n.s.	1.30 **	0.71 *	1.02 n.s.
Place of residence: Rural areas (versus others)	0.84 n.s.	0.81 **	0.91 n.s.	0.88 n.s.
Parental role model: Positive (versus negative)	1.19 n.s.	0.97 n.s.	1.21 n.s.	0.99 n.s.
Vehicle availability: Unlimited (versus limited)	1.19 n.s.	1.24 **	2.28 ***	2.40 ***
Combination negative parental role model/ lower educational attainment (versus others)	1.40 *	1.31 *	1.40 *	1.32 *
Combination higher educational attainment/ limited vehicle availability (versus others)	0.88 n.s.	0.79 *	0.66 **	0.59 ***
Driving licence model: AD17 (versus conventional model) 95% confidence interval	0.74 *** 0.64 – 0.86	0.80 ***	0.79 ** 0.68 – 0.92	0.85 **
Goodness of fit of the regression model: Likelihood ratio (chi-squared)	p = 0.855		p = 0.806	

Legend: n.s. = Difference to parity (1.0) not significant; * = statistically significant ($p \leq 0.05$);
** = statistically very significant ($p \leq 0.01$); *** = statistically highly significant ($p \leq 0.001$)

Interpretation example (row "Gender"): The ratio of VZR-recorded traffic offences per million kilometres among female novice drivers compared to their male counterparts is 0.47. This means that the frequency of traffic offences among female drivers is lower by 53%.

Tab. 99: Comparison of the identified effects on traffic offences when using objective VZR data versus survey response (as taken from the two corresponding columns of Tab. 86)

of survey responses to VZR data records is thus not merely a switch from subjective to objective data, but also a switch to incidents of greater relevance.

Conclusion

The testing of effectiveness on the basis of objective data retrieved from the VZR fully confirms the effectiveness of the AD17 model determined on the basis of survey responses.

6.2.8 Does voluntary participation in a road safety study itself influence driving behaviour?

The objection that participants could be influenced by their knowledge of the study objective is justified in principle. However, there is no reason to assume that this objection does not apply equally to both analysis groups. Distortion of an equal degree is unproblematic from the methodical view point, because the present evaluation is based solely on relative comparisons between the groups and not on absolute figures.

It is furthermore questionable, whether the knowledge of being under observation actually exerts an influence on driving behaviour in the present case: Significant conscious impression management by study participants, which may well be revealed in behavioural studies with observation periods of a few minutes, is scarcely conceivable over an observation period of several months subject to the demanding interactions of road traffic.

A second potential bias which is independent of the influence of observation is "self-selection" to participate in the survey. The assumption here is that persons who volunteer information about their behaviour and even give permission to inspect their

Data sources	Paper and online questionnaires and VZR data records
Conditions	Selection: Only clearly identified VZR cases (99%)
Analysis groups	Contacted groups Ek and Kk (20,138), silent groups Es1 and Ks1 (27,579), and silent groups Es2 and Ks2 (47,538)
Analysis periods	a) 12 months before start of solo driving, b) First 12 months of solo driving

Tab. 100: Analysis conditions and numbers of cases

Analysis group	VZR-recorded offences per 1,000 drivers and year	
	E	K
Voluntary participation (contacted groups: Ek and Kk)	3.9	5.4
No personal contact (silent groups: Es1, Es2 and Ks1, Ks2)	6.3	7.2

Tab. 101: Rates of VZR-recorded traffic offences (all forms of traffic participation) during the 12 months before the start of solo driving per 1,000 drivers and year for the contacted and silent groups

VZR data records must be convinced that they have nothing to hide.

With regard to the effects of self-selection, an empirical study by HEINZMANN and SCHADE (2003; p. 56) came to the conclusion that participants tend to possess a higher level of education, have gathered more driving practice, are less likely to be aggressive drivers and display generally more appropriate driving behaviour (measured by the number of entries in VZR records) than could be expected on average; they also express greater acceptance of road safety measures." A self-selection effect in the sense of generally "better" behaviour and specifically a reduced risk of accident or traffic offences must thus be expected among the survey participants.

To clarify these and other questions, VZR data records were retrieved and evaluated anonymously for "silent" analysis groups which had not been contacted personally (regarding the concept, see Section 2.1.1; regarding the sampling method, see Section 2.3.1). Tab. 100 gives an overview of the cases taken into account in this section of the analysis.

Prior VZR records (12-month pre-test phase)

VZR records at the start of solo driving (including all forms of traffic participation in this instance) stem from a time at which the respondents had not yet received the request to take part in a survey, i.e. they were not yet aware that they would later be completing the questionnaires. Two typical effects are nevertheless revealed (calculated from the values underlying Tab. 101; the actual figures should not be overestimated and should only be used in relevant context, because the underlying sample sizes are too small to permit meaningful statements for such low frequencies of occurrence):

- When starting solo driving, persons who later participated voluntarily in the survey had 25% (Kk) and 38% (Ek) fewer VZR entries than those who were analysed anonymously (Ks and Es).
- When starting solo driving, persons who had participated in the AD17 model had 12 to 27% fewer VZR entries than conventional licence holders, despite their earlier participation in road traffic with a motor vehicle.

The first point confirms the described self-selection effect, namely that persons who have nothing to disclose are more willing to participate. The aforementioned study by HEINZMANN and SCHADE (2003; Tab. 10) even reported a prior offence rate which was a considerable 50% lower among volunteer study participants (N > 1,000) compared to those whose VZR records were analysed anonymously (N = 804).

The second point could at least in part be a direct consequence of the differences described in Section 5.2.2, in particular the higher educational attainment among AD17 candidates, the lower availability of other vehicles beside the car, the more positive parental role model with regard to compliance with road traffic rules and the more frequent place of residence in rural areas. Furthermore, the first positive effects of the AD17 model could already influence participants' driving behaviour with other vehicles, as the prior phase considered here coincides to a large extent or even fully with the phase of accompanied driving.

VZR entries during the phase of solo driving (12-month post-test phase)

Period-based rates of accidents and traffic offences, i.e. rates per 1,000 drivers and year, are available for all analysis groups. The silent sub-

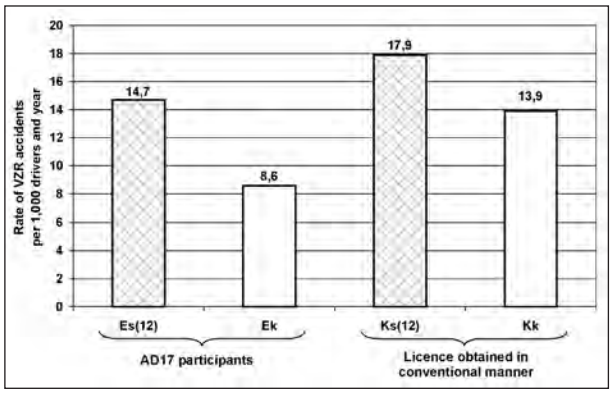

Fig. 30: Rates of VZR-recorded at-fault car accidents during the first 12 months of solo driving per 1,000 drivers and year in the contacted and silent analysis groups

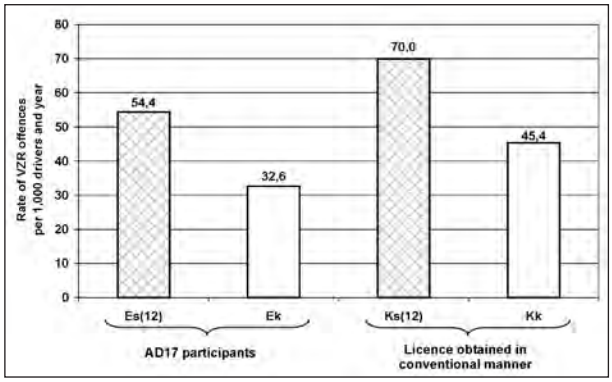

Fig. 31: Rates of VZR-recorded traffic offences while driving a car during the first 12 months of solo driving per 1,000 drivers and year in the contacted and silent analysis groups

groups Es1 and Es2 are combined to form the Es group, and the silent sub-groups Ks1 and Ks2 are combined to form the Ks group.[88] To ensure comparability, only incidents during the first 12 months are taken into account for these groups. Fig. 30 and Fig. 31 present the results.

The figures displayed in Fig. 30 and Fig. 31 were used to calculate the effects of the AD17 as dependent on the nature of the analysis group (contacted versus silent group), the factor analysed

Source	Parameter	Comparison of analysis groups: Ek vs. Kk	Comparison of analysis groups: Es vs. Ks
VZR	At-fault accident	-38%	-18%
	Offence* with fine of at least €40	-28%	-22%

* = including relevant accidents ("VZR offences");
Interpretation example: The accident rate per 1,000 drivers and year calculated from the VZR data records of the contacted groups is 38% lower for AD17 drivers than for drivers who obtained their driving licence in the conventional manner.

Tab. 102: Summary of the period-based AD17 effects determined from VZR data for a 12-month observation period: Reduced rate of accidents and traffic offences in the Ek group compared to the Kk group as a percentage ("gross effects")

(accident, traffic offence) and the data source (self-reported behaviour versus VZR data records); the results are compared in Tab. 102. It is to be noted that this table shows only the "gross effects" of the AD17 model.[89] When the volunteer groups Ek und Kk (left-hand column) are compared to the silent samples Es and Ks (right-hand column), the effect of the AD17 model, namely a reduction in the frequency of accidents and traffic offences, is rather more prominent: 38% reduction compared to 18%, and 28% compared to 22%. It is possible that this finding is in part attributable to the self-selection effect of survey participation and less to the experience gained from accompanied driving.

The figures contained in Fig. 30 and Fig. 31 also show that the rate of VZR-recorded accidents is 22% lower in the contacted group Kk and 41% lower in the contacted group Ek than in the corresponding silent groups Es and Ks. With reference to VZR-recorded traffic offences, the rate is 35% lower in the Kk group and 40% lower in the Ek group.[90] These reduced rates correspond approximately to the findings reported above with regard to prior VZR records.

A considerable self-selection effect is thus prevalent among the volunteer study participants: The willingness to participate in the survey is associated not only with a 25 to 38% lower rate of accidents and traffic offences in the year before starting solo driving (as already determined above), but also with an approximately 20 to 40% lower rate during the first year of solo driving.

More critical than the absolute extent of the self-selection effect, however, is the fact that it is

88 Note: Group 1 (Es1, Ks1) recruited from 10 federal states, Group 2 (Es2, Ks2) from 11 federal states (see Tab. 5).

89 As determined on the basis of the survey data in Section 6.2.3, the "net effects" after adjustment for distorting variables such as gender and vehicle availability are somewhat lower.

90 For comparison: The aforementioned study by HEINZMANN und SCHADE (2003; Tab. 33) reports that the rate of VZR-recorded offences during the observation phase was around 22% lower among volunteer study participants than among comparable drivers whose VZR records were analysed anonymously.

apparently more prominent in the Ek group than in the Kk group: The rate of prior VZR records among the volunteer study participants is lower than that of the corresponding silent groups by 38% instead of 25%; the reduction with regard to VZR-recorded offences during the first 12 months of solo driving is 40% instead of 35%, and with regard to VZR-recorded accidents 41% instead of 22% (all figures from the section).

Differences in self-selection with regard to survey participation can impair the stringency of conclusions on the effectiveness of the AD17 model and must thus be analysed more closely.

Closer analysis and evaluation

The fact that AD17 drivers in the participating analysis groups are less conspicuous in their driving behaviour than AD17 drivers who did not take part in the survey is not necessarily due to increased effectiveness of the AD17 model among volunteer participants. It could attributable in part, as described above, to more prominent self-selection regarding survey participation and the associated reduced rates of accident and traffic offences. But why should AD17 drivers be prone to a greater self-selection effect that those who obtain their driving licence in the conventional manner?

As demonstrated by the analysis of personality factors in Section 5.2.2, no systematic differences in personality structure were found between the Ek and Kk groups which could explain or even lend plausibility to a reduced risk of accident involvement or traffic offences in the Ek group. There are two points, however, which indicate that such an effect is not totally improbable: Members of the Ek group are more often planning to obtain an advanced school-leaving certificate (55.3% compared to 45.5% in the Kk group; see Tab. 29). Furthermore, drivers in the Ek group report slightly more frequently that their parents abide strictly by road traffic rules (see Tab. 48).

In addition to these points, there are possibly further, more important factors which already differentiate AD17 drivers and conventional driving licence holders, apart from their experience of the AD17 model. This was already mentioned as a methodological problem in Section 4.5. We are faced with a second form of self-selection alongside self-selection relating to survey participation, namely self-selection relating to participation in the AD17 model.

Even though this second form, namely the decision in favour of AD17, is logically completely independent of the first, namely the decision to participate in the survey, a de facto correlation is apparent. Those who made one participation decision were more likely to make also the second: As reported in Section 3.2 (Tab. 13), 47.0% of the contacted AD17 drivers, but only 27.2% of the contacted non-AD17 drivers took part in the voluntary survey.[91] It seems that the decisions to participate in the AD17 model and in the survey are in part governed by the same factors, namely by factors which simultaneously serve as risk-reducing factors and thus generally reduce the rates of analysis-relevant driving behaviour.

Even if these factors of “openness” towards participation in various measures are not yet known in detail, they can nevertheless be made responsible for the noticeably more prominent AD17 effect among the volunteer study participants. The extent to which non-participants lack these hypothetical factors is reflected in their greater propensity for involvement in traffic offences or traffic accidents. The survey, therefore, does not itself reduce the rates of accident and traffic offences (and this effect was not to be expected), but instead results in internal differentiation with regard to driving behaviour between the survey participants and non-participants.

A second possibility for interpretation leads to the same conclusion: Persons who participate voluntarily in survey studies display personality traits which not only lower their general risk of accident involvement or traffic offences, but furthermore make them specifically more receptive for the positive influences of driving with accompaniment. In such a group of volunteers, therefore, the AD17 effect is more prominent than among those who refuse to participate in the survey. The enhanced AD17 effect is solely a result of internal differentiation between voluntary participants and decliners in the AD17 group: For those AD17 drivers who refuse to take part in the survey, the AD17 effect is less pronounced than for those who participate. The methodological problem

[91] Even among the volunteers there were considerable differences in cooperativeness: AD17 drivers were more frequently prepared to go to the trouble of gathering vehicle data for the survey, e.g. mileage or year of vehicle registration (see Tab. 65 to Tab. 67 in Section 5.4.1).

for survey studies lies in the fact that no survey data exist for the group of non-participants, and consequently the overall effect for survey participants and non-participants cannot be quantified.

Use of the results of voluntary surveys alone is not acceptable according to both interpretations and would produce a distortedly positive impression of the causal effectiveness of the AD17 model (in the sense of Hypothetical effect 3; see Section 1.2).

Conclusion

It is considered improbable that awareness of being under observation influences the driving behaviour of the study participants to any significant extent over an observation period of 12 months. A considerable self-selection effect is, however, demonstrated among participants who volunteered in the survey: Those who agreed to take part in the survey had an approximately 30% lower rate of accidents or traffic offences. A number of the – predominantly still unidentified – factors which promote voluntary survey participation have a simultaneous positive effect on driving safety.

If all groups were to display an equally enhanced level of driving safety, this would not affect the chosen analysis design of the evaluation, which is based on relative differences between the groups rather than on absolute figures. Unfortunately, however, the self-selection effect relating to survey participation appears to be more prominent in the group of AD17 drivers than among drivers who obtained their driving licence in the conventional manner. A probable explanation for this particular characteristic of AD17 drivers is seen in a correlation between the two self-selection effects involved: The effects relating to AD17 participation and survey participation are in part dependent on the same factors, namely factors with a risk-reducing influence.

If an enhanced effectiveness of the AD17 model is identified on the basis of a study with voluntary participation, this may be due to the risk-reducing factors which characterise persons who choose to participate not only in the AD17 model, but also in the survey. The enhanced effectiveness of the AD17 model among volunteers can thus be attributed to selection effects. Selection effects mean internal differentiation in the sense of Hypothetical effect 2 (see Section 1.2).

In the light of this problem, it is urgently necessary to verify the results determined from the analysis of volunteer survey participants before generalisation, for example through comparison with the silent analysis groups which are not subject to self-selection (and observation) effects (see Section 6.3.4).

6.3 Extended topics of the evaluation

6.3.1 Are factors apparent which are beneficial for the AD17 effect?

It is possible that the AD17 model, as it is currently implemented, is still not optimal. If this is the case, the effect calculations presented here actually underestimate the true potential of accompanied driving. Are factors apparent, in addition to the duration and the distance of accompanied driving practice (dealt with in Section 6.2.6), which could enhance the success of the AD17 model?

One possibility is the gender of the accompanying passenger, especially as studies document the positive influence of female passengers on young drivers (WILLIAMS, 2003, presents such findings). The hypothesis that a female accompanying driver could enhance the effect of the AD17 model, and that this effect could also be dependent on the gender of the driver, was tested on the basis of the present data.

The age of the accompanying passenger could also play a role for the effectiveness of the model. To investigate this possibility, the accompanying passengers were divided into two groups: Those under 50 years of age and those over 50. As a final factor, the influence of any relevant driving incident (accident or offence penalised with a fine of €15 or more) during the accompanied driving phase was considered. Such an incident could be an indicator of a poorer prognosis, but equally also the starting point for learning on the part of the novice driver. The analysis conditions and the number of cases corresponded to those of Section 6.3.1 (see Tab. 90). The type and frequency of reported incidents during the accompanied driving phase are shown in Tab. 62. Cases of minor damage due to manoeuvring errors when parking, however, were considered trivial at this point and are thus not taken into account.

The results of the four Poisson regressions for accident involvement and traffic offences, each on

the basis of both time and kilometres driven, are shown in Tab. 103 (the rows containing new results are highlighted grey): There is no evidence that the gender or age of the accompanying passenger during the accompanied driving phase influenced the relevant driving behaviour of the participant during the observation period; the main effects for the accompanying driver were not significant in any of the four analyses.

No interactions, e.g. between the gender of the driver and the accompanying person, were found for accident involvement and traffic offences. In all four cases, a regression model comprising solely main effects, in other words a model which assumes zero interactions, was fully compatible with the data (the Pearson chi-squared ratios of model fit produced probabilities between 0.44 and 0.93). There is thus no combination of driver and accompanying driver gender which is significantly better than all others in the context of the AD17 model. The same applies to combinations of driver gender and age of the accompanying passenger.

The effect of a critical incident during the accompanied driving phase, on the other hand, is consistently negative. Such incidents were reported by 5.5% of the AD17 drivers. Where a (penalised) traffic offence or even an accident was recorded during this phase, the rates of accident involvement and traffic offences were considerably higher during the subsequent one-year phase of solo driving under observation (third highlighted row in Tab. 103).

In this case, however, it is necessary to consider a methodical particularity: A correlation exists between the kilometres driven during and after the accompanied driving phase. The distance driven acts as a confound and produces a spurious correlation. A person who drives a greater distance is subject to greater "exposure" and thus has more "opportunity" for accident involvement or traffic offences. For this reason, only the kilometre-based rate must be used to draw conclusions, as this parameter is independent of the amount of driving practice and therefore immune to this form of spurious correlation.

Even after taking this precaution, driving incidents which occur during the accompanied driving phase (with no distinction being made between accidents and traffic offences) entail a 69% higher rate of accident involvement and an increase of even 84% in the rate of traffic offences per million kilometres during the subsequent phase of solo driving. Penalties for driving incidents thus fail to trigger any changes in subsequent driving behaviour. Whilst the group of persons concerned is only small (5.5% of novice drivers), it nevertheless requires particular attention.

Conclusion

There is no evidence that the age or gender of the accompanying passenger enhance the effectiveness of the AD17 model. The same applies to combinations of these factors and to

Characteristics	Ratios of accident involvement and traffic offences compared to the relevant reference group			
	Accident involvement		Traffic offences	
	per million kilometres	per 1,000 drivers and year	per million kilometres	per 1,000 drivers and year
Gender of driver: Female (versus male)	0.98 n.s.	0.73 ***	0.68 ***	0.51 ***
Gender of most frequent accompanying passenger: Female (versus male)	1.02 n.s.	1.01 n.s.	0.98 n.s.	0.96 n.s.
Age of most frequent accompanying passenger: 50 years and older (versus younger)	1.15 n.s.	1.05 n.s.	1.14 n.s.	1.04 n.s.
Offences or accidents during accompanied driving phase: Recorded (versus not recorded)	1.69 ***	2.12 ***	1.84 ***	2.36 ***
Goodness of fit of the regression model: Likelihood ratio (chi-squared)	p = 0.438	p = 0.929	p = 0.607	p = 0.859
Legend: n.s. = Difference to parity (1.0) not significant; * = statistically significant ($p \leq 0.05$); ** = statistically very significant ($p \leq 0.01$); *** = statistically highly significant ($p \leq 0.001$)				

Tab. 103: Influence of the gender and age of the most frequent accompanying passenger and of critical incidents during the accompanied driving phase on rates of accident involvement and traffic offences in the period under observation

combinations with the gender of the driver. Accidents and traffic offences recorded during the accompanied driving phase lead to a poor prognosis for future driving behaviour.

6.3.2 Are there any undesirable side effects of the AD17 model?

The accompanied driving model refers only to use of a car. At the same time, however, AD17 participants are permitted to use a moped without accompaniment, and above all without being required to obtain a specific moped or motorcycle licence. It is thus conceivable that AD17 drivers could make use of this additional possibility to a greater extent, and as a result of their corresponding lack of skills and knowledge are more likely to be involved in accidents or commit traffic offences.

Tab. 104 gives an overview of the cases taken into account by the analysis in this section. Tab. 105 presents figures on accident involvement and traffic offences while riding a moped during the relevant observation periods.

Data sources	VZR data records
Conditions	Only clearly identified VZR cases (99%): Only incidents while riding a moped when in possession of a valid licence
Analysis groups	Group 1 (Es1 and Ks1: 27,579), Group 2 (Es2 and Ks2: 47,538)
Analysis periods	Es1 and Es2: Duration of the accompanied driving phase, Ks1 and Ks2: 12 months before obtaining a driving licence

Tab. 104: Analysis conditions and numbers of cases

Analysis group	Es	Ks
Total number of persons	37,574	37,543
Total years of observation	21,657	37,543
Average observation period per person (in months)	6.9	12.0
Number of recorded accidents with moped	8	8
Number of recorded traffic offences with moped (excluding accident involvement)	29	81
Rate of recorded accidents with moped per 1,000 persons and year	0.4	0.2
Rate of recorded traffic offences with moped per 1,000 persons and year (excluding accident involvement)	1.3	2.2

Tab. 105: Number of persons, years of observation, moped-related VZR records from the months before the person's 18th birthday and the rates of incidents per 1,000 persons and year in the silent analysis groups

Very few moped incidents are recorded for both AD17 participants and holders of a conventional driving licence. There is a small tendency for AD17 drivers to be involved more frequently in accidents[92], but they are slightly less likely to commit traffic offences not connected with an accident.

Conclusion

Participation in the AD17 model and thus permission to ride a moped without a specific test at the age of 17, does not appear to result in an increased rate of accidents and traffic offences in connection with mopeds.

6.3.3 Is the overall result still positive when accidents and traffic offences during the accompanied driving phase are taken into account?

As presented in Section 5.3 (Tab. 62), a small percentage of AD17 drivers reported accidents and traffic offences during the phase of accompanied driving. Fair evaluation requires that these incidents are taken into account (cf. GREGERSEN, NYBERG & BERG, 2003). It could otherwise be argued that accompanied driving does not actually reduce the rates of accident involvement and traffic offences, but merely shifts these incidents into an earlier phase of driving. If this effect were to be confirmed, the positive result of the AD17 model would have to be corrected accordingly.

One generous, but essentially acceptable approach would be to distribute the incidents from the phase of accompanied driving over the whole prospective driving career of the AD17 drivers. As only few incidents are to be spread over several decades, however, the correction factor would be so small that correction in the end becomes superfluous.

Another possibility is to relate the accidents and traffic offences from the accompanied driving phase to those recorded for the reference group at the same age, namely in the months before obtaining a driving licence.

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92 The samples are too small to permit statistical significance testing of these differences.

Data sources	VZR data records
Conditions	Selection: Only clearly identified VZR cases (99%); Counting: VZR offences, i.e. including accidents
Analysis groups	Silent groups E1+E2 (37,574), silent groups K1+K2 (37,543)
Analysis period	12 months before start of solo driving

Tab. 106: Analysis conditions and numbers of cases

The data retrieved from VZR records for the silent analysis groups were taken as the basis for this comparison. Persons whose VZR records could not be identified unambiguously (see footnote 27; approx. 1%), however, could not be taken into account. It was counted, how many persons had a car-related incident entered in their VZR records during the last 12 months before starting solo driving.[93] The analysis thus includes all car-related incidents recorded for the AD17 group during the accompanied driving phase. For purposes of comparison, the remaining VZR data records from the period concerned were also retrieved, in other words records for incidents which were not car-related. Tab. 106 shows the relevant analysis conditions and the case numbers included.

Consideration of VZR-recorded offences in general

First of all, VZR-recorded offences were considered in general, i.e. all VZR offences, including accidents. Since accidents were not yet a specific subject for the first part of this section, reference is here made simply to traffic offences, even though some of the cases were connected with an accident. The results are presented in Tab. 107.

A generally low level of analysis-relevant incidents was found in both the Es and Ks groups in the year before issuing of a full driving licence, though young men displayed considerably more negative behaviour. In the group with the highest rates, namely young men who obtained their driving licence in the conventional manner at the end of the year under observation, the rate of VZR-recorded offences overall (irrespective of the type of vehicle) was 13 per 1,000 drivers and year. Among young men who participated in the AD17 model, on the other hand, it was only 11 per 1,000 drivers and year, and that despite the fact that already almost twice as many car-related offences were recorded in this group compared to drivers who later obtained a conventional driving licence.

	Analysis group			
	Es group		Ks group	
	male	female	male	female
Number of persons:	18,576	18,998	19,373	18,170
Car-related offences (of which in accompanied driving phase)	97 (95)	31 (31)	51	7
Offences other than car-related offences	103	6	207	5
Total	200	37	258	12

Tab. 107: Numbers of car-related and other VZR-recorded traffic offences during the 12 months before the start of solo driving

With the rates of VZR-recorded offences for female novice drivers being generally much lower, the comparison was less favourable for the AD17 model. The significant conclusion, however, is the fact that the group of AD17 drivers does not appear to display an overall higher rate of VZR-recorded offences (irrespective of the vehicle driven) before starting solo driving. Despite their participation in road traffic as (accompanied) car drivers, they committed only 6.3 offences per 1,000 drivers and year, compared to 7.2 per 1,000 drivers and year in the Ks reference group.

At this point the following conclusion could be drawn: There is certain evidence that the risk of traffic offences is shifted forward into the accompanied driving phase; this effect is so minor, however, that it does not lead to a higher rate of VZR-recorded offences in the year prior to the driver's 18th birthday compared to those who obtain a driving licence in the conventional manner; it can thus be discounted for the present evaluation of the AD17 model.

This line of argument may be justified to some extent. Observing scientific principles, however, a strictly conservative approach is to be taken in the following, namely testing of the null hypothesis against the hypothesis of AD17 effectiveness. To this end, the analysis was limited to car-related traffic offences. After all, AD17 drivers are legally

[93] Likewise in the Ks group, namely drivers who obtained a driving licence in the conventional manner

entitled to use a car in road traffic and should thus display a considerable poorer performance than the reference group, which is not permitted to drive. A comparison of these traffic offences should thus degrade the overall result for the AD17 drivers and hamper the proof of effectiveness.

Taking the data presented in Tab. 107, 128 car-related offences per 37,574 persons and year in the Es group are compared against 58 car-related offences per 37,543 persons and year in the Ks group. This corresponds to 3.4 car-related offences per 1,000 drivers and year for AD17 drivers, compared to 1.5 for drivers who obtained a driving licence in the conventional manner. These figures are to be used in the further analysis.

Critics could still challenge even these figures, however, by referring to the content of footnote 56, namely that significant under-reporting of offences committed during the accompaniment phase is to be expected in VZR data records. A second analysis was thus performed for the AD17 group to take into account the possible (but by no means proven) under-reporting effect. This second approximation presented here should, however, be viewed as an extreme upper limit.

If a rate of VZR under-reporting of 75% is assumed, the number of car-related traffic offences during the phase of accompanied driving must be multiplied by four to compensate the undisclosed cases. This would lead to a total of 506 offences[94] per 37,574 persons and year for the Es group instead of 128 offences. This corresponds to 13.5 car-related offences per 1,000 persons and year for the AD17 drivers over the period between their 17th and 18th birthdays.

A graph was plotted to illustrate the extent to which the prior VZR records calculated by the two methods deteriorate the overall result of the AD17 model. To this end, VZR-recorded offences from the first 12 months of solo driving were cumulated for the combined silent analysis groups Es and Ks, with approx. 37,500 persons each (Fig. 32). All car-related offences from the prior phase are taken into account as a “handicap” at the beginning of the observation period. The curve thus begins not at the origin, but with a positive offset, i.e. “with a handicap” (Fig. 32).

The graph shows that AD17 drivers already display a lower rate of traffic offences than holders of a conventional driving licence after the first month of the period under observation, despite the greater handicap. Tallying the car-related traffic offences of AD17 drivers during the accompanied driving phase against the prior car-related offences of the reference group produces a negative result for the AD17 drivers; there is nevertheless still a considerable advantage for the AD17 model at the end of the first year of driving practice (see Fig. 32). The reduction in first-year traffic offences in the AD17 group is merely lower when the handicap is applied[95]: The loss for the overall effectiveness is three percentage points (or 14% relative).

The extreme assessment based on the assumption of significant VZR under-reporting during the accompanied driving phase, on the other hand, produces a dramatically increased handicap for the AD17 group (dashed line in Fig. 32). In this case, the overall result of the AD17 model only reaches the “break-even point” after more than eight months. At the end of the year, the overall effectiveness suffers a heavy loss of 17 percentage points (74%)[96]. But even in this extreme case, the hypothesis of a complete shift of traffic offences into the phase of accompanied driving is not tenable.

Moreover, adding the whole handicap from the prior phase to the first year of driving practice seems unfair. A reasonable timeframe for evaluation of the effectiveness of models aimed at novice drivers is at least two years[97]. Using the cumulated data on traffic offences for silent group 1, it is possible – albeit on the basis of a much narrower database – to plot a second graph similar to Fig. 32 with a time axis of 24 months (not depicted here). When using this longer “redemption period” of two years of solo

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94 Namely (4 x 95) + 2 for the male drivers plus (4 x 31) + 0 for the female drivers

95 Namely from an original reduction of 23% to only 20% after taking the handicap into account (Note: These figures were calculated using the cumulated values with and without handicap from the table underlying the graph; the table itself is not depicted here. The figures are only applicable for the limited partial analysis presented in this section.)

96 From an original reduction of 23% to only 6% after taking the handicap into account (see explanatory note at footnote 95)

97 After re-analysis of longitudinal data from an earlier study of the legal proving of novice drivers over the first four years, SCHADE (2001, cited in WILLMES-LENZ, 2002, p. 21) comes to the conclusion that novice drivers require on average approx. two-and-a-half years of driving practice to reduce their initial accident risk (excluding a residual risk which is not influenced by experience) by 90 per cent. A period of at least two years thus represents a more meaningful timeframe.

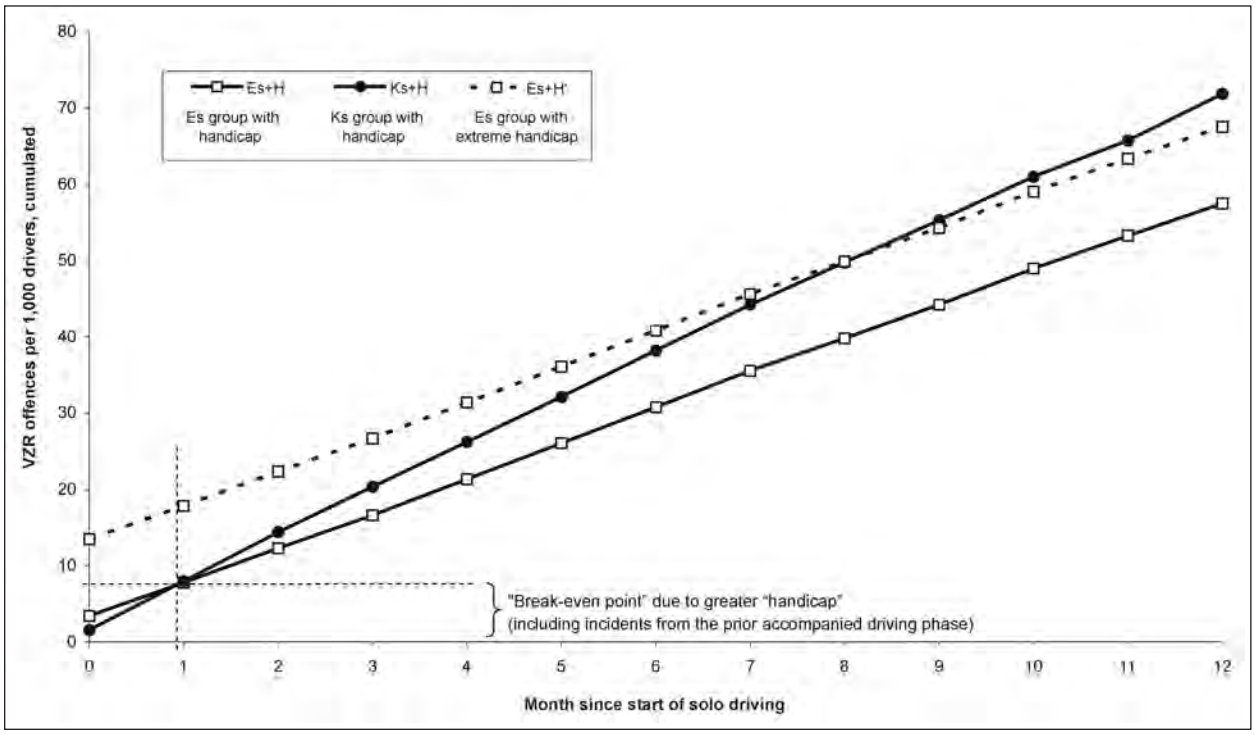

Fig. 32: Cumulated VZR-recorded offences since the start of solo driving per 1,000 drivers for the Ks group of conventional licence holders (solid circles) and for the Es group of AD17 participants (unfilled squares), taking into account the applicable "handicaps" from the prior phase (the dashed line represents the analysis based on an extreme handicap for the AD17 drivers)

driving, the application of the handicap from the prior phase naturally decreases the overall effectiveness of the AD17 model to a lesser degree[98], namely by two percentage points (10%) or by eight percentage points (almost 50%) in the extreme case. By comparison, the aforementioned figures for consideration of a one-year period: Here, the handicap decreased the overall effectiveness by three percentage points (14%) or by 17 percentage points (74%) in the extreme case.

Consideration of VZR-recorded accidents

The targeted consideration of car accidents permits an even sharper assessment of the possible shift of analysis-relevant driving behaviour into the phase of accompanied driving. To this end, the VZR-recorded at-fault accidents as driver of a car were counted ("VZR accidents"; see Tab. 108, row highlighted grey).

Taking the data presented in Tab. 108, 39 car accidents per 37,574 persons and year in the Es group are placed against 15 car-related accidents per 37,543 persons and year in the Ks group. That corresponds to 1.0 accidents per 1,000 drivers and year for AD17 drivers, compared to 0.4 for drivers who obtained a driving licence in the conventional

	Analysis group			
	Es group		Ks group	
	male	female	male	female
Number of persons:	18,576	18,998	19,373	18,170
Car-related offences (of which in the accompanied driving phase)	97 (95)	31 (31)	51	7
of which at-fault accidents (of which in the accompanied driving phase)	26 (25)	13 (13)	9	6

Tab. 108: Number of car-related VZR-recorded offences, distinguishing at-fault accidents (row highlighted grey), during the 12 months before the start of solo driving

manner. The figures represent the handicap to be applied in a new graph of the cumulated VZR-recorded car accidents (in the same way as in Fig. 32). All car accidents from the one-year prior phase are again taken into account at the beginning of the observation period (Fig. 33).

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98 From an original reduction of 18% to only 16% after taking the handicap into account (see explanatory note at footnote 95)

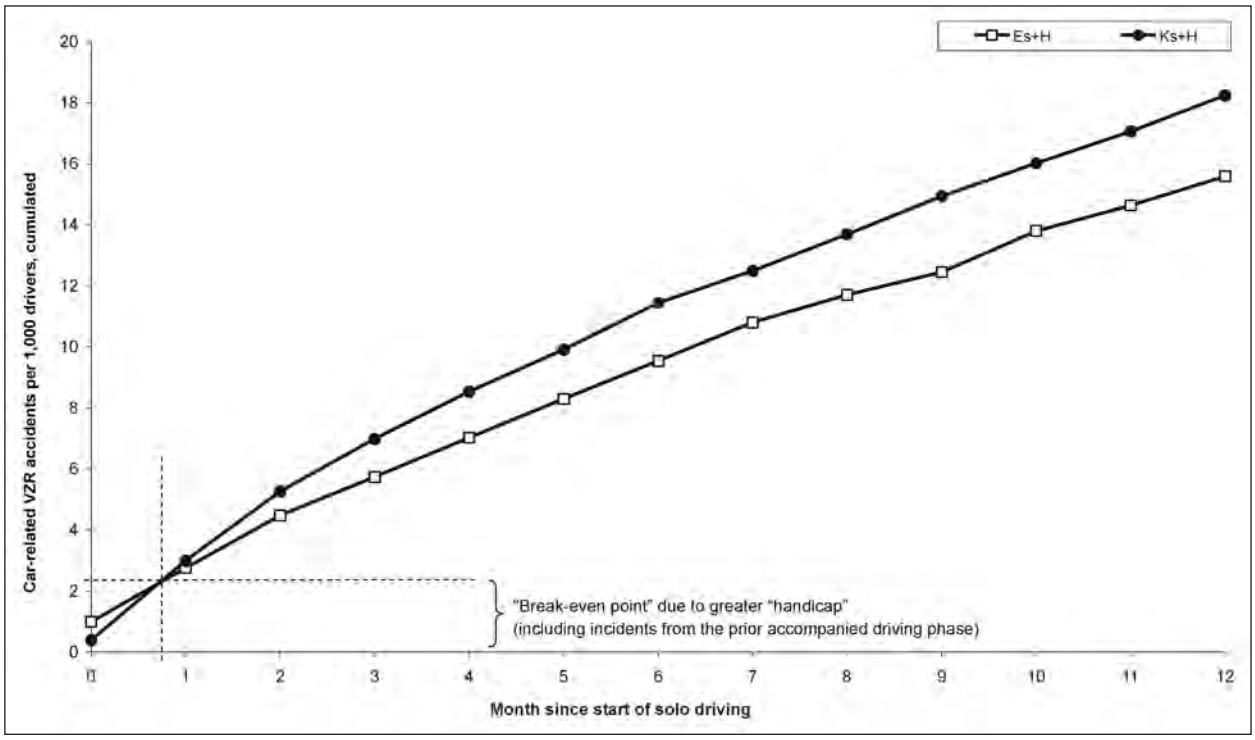

Fig. 33: Cumulated car-related VZR accidents since the start of solo driving per 1,000 drivers for the Ks group of conventional licence holders (circles) and for the Es group of AD17 participants (squares), taking into account the applicable "handicaps" from the prior phase

The graph (Fig. 33) shows that AD17 drivers already display a lower rate of accidents than holders of a conventional driving licence after less than one month, despite their greater handicap from the accompanied driving phase. In line with expectation, the application of a handicap narrows the reduction in the rate of accidents in the AD17 group during the first year[99]: The loss for the overall effectiveness is four percentage points (approx. 20%).

Here, too, a "redemption period" of two years seems more reasonable: Taking the cumulated data on VZR accidents, it is possible – albeit on the basis of the much narrower database of silent group 1 – to again plot a second graph similar to Fig. 33 but with a time axis of 24 months (not depicted here). When applied to this longer "redemption period" of two years of solo driving, the application of the handicap from the prior phase naturally decreases the overall effectiveness of the AD17 model to a lesser degree[100], namely by two percentage points (10%). By comparison, the aforementioned figures for consideration of a one-year period: Here, the handicap decreased the overall effectiveness by four percentage points (20%).

An alternative analysis to test the (unproved) assumption that a significant under-reporting effect is to be expected during the accompanied driving phase is not considered necessary at this point: While it may well be possible for accompanying parents to successfully take on the blame for traffic offences, this appears less plausible in the case of at-fault accidents.

The observed ratio of VZR accidents during the accompanied driving phase to VZR accidents during the subsequent phase of solo driving is 1.0 (Es group before Month 0 in Fig. 33) to 15.6 (Es group after 12 months) minus 1.0, in other words 14.6 per 1,000 drivers and year. The period-based accident rate is thus 14.6 times higher during the period of solo driving than during the phase of accompanied driving. If this comparison is performed with the accident rate of the drivers who obtained a driving licence in the conventional manner instead of with the low accident rate of AD17 drivers during the phase of accompanied

99 From an original reduction of 18% to only 14% after taking the handicap into account (see explanatory note at footnote 95)

100 From an original reduction of 18% to only 16% after taking the handicap into account (see explanatory note at footnote 95)

driving, then the ratio is even 17.8 to 1: The period-based accident rate of drivers obtaining a conventional driving licence is thus 17.8 times higher during the first year of solo driving than the accident rate of AD17 drivers during the accompanied driving phase.

Similar results were reported by GREGERSEN, NYBERG und BERG (2003) for corresponding analyses of the Swedish model: They calculated a ratio of 33.3 to 1 for accident involvement recorded by the police in the period-based analysis; this ratio was reduced to 10.2 to 1, however, when based on the kilometres driven.

Conclusion

The analysis investigates the challenge that the AD17 model merely shifts accident involvement and traffic offences into an earlier period. The results show that this challenge is only justified to a minor extent: The tallying of incidents from the year before the driver's 18th birthday with those during the first year of solo driving produces a reduction in the overall positive effect of the AD17 model in line with expectation, but only by four percentage points in the case of accidents and by three in the case of traffic offences. The decrease in the overall effectiveness is even smaller when based on the more reasonable “redemption period” of two years of solo driving, namely only two percentage points for both accidents and traffic offences.

If the accidents and traffic offences recorded before the start of solo driving, i.e. above all those of the accompanied driving phase, are taken into account, this reduces the overall positive result of the AD17 model slightly, but remains far short of negating the effect.

6.3.4 Is it possible to replicate and generalise the results? (replication study)

Before generalisation of the results obtained with the data from volunteer survey participants, these results should be verified on the basis of the independently gathered data for so-called silent analysis groups, for example to exclude self-selection effects (see Section 6.2.8).

The silent analysis groups were recruited from the Central Register of Driving Licences (ZFER) in the same way as the contacted groups, except that they were not specifically asked to participate (regarding the analysis concept, see Section 2.1.1; regarding the sampling method, see Section 2.3.1). The VZR records of these persons were retrieved for an observation period of more than 25 months in Group 1 and more than 16 months in Group 2 (Tab. 109).[101]

Both self-selection effects relating to survey participation and observation effects (the knowledge that driving behaviour is under observation) are excluded in the silent analysis groups. The following analysis thus serves not only as a mere replication of the findings, but also transfers to situations which are free of any artificial study conditions. The bottom two rows of Tab. 109 present the calculated rates of car-related accidents and traffic offences per 1,000 drivers and year in the silent analysis groups.

The purpose of the analysis is to determine whether the results based on self-reported behaviour in

101 Regarding the difference between Groups 1 and 2, see Tab. 5

Analysis group:	Es1	Ks1	Es2	Ks2
Total number of persons	13,787	13,792	23,787	23,751
Total years of observation	29,127	28,779	32,698	32,215
Average observation period per person (in months)	25.4	25.0	16.5	16.3
Number of recorded at-fault car accidents	342	422	422	518
Number of recorded car-related traffic offences (including at-fault accidents)	1,712	2,036	1,760	2,107
Rate of recorded at-fault car accidents per 1,000 drivers and year	11.7	14.7	12.9	16.1
Rate of recorded car-related traffic offences per 1,000 drivers and year (including at-fault accidents)	58.8	70.7	53.8	65.4

Tab. 109: Number of persons, years of observation, car-related VZR records and the rates of these accidents and traffic offences per 1,000 drivers and year in the silent groups (comparability is problematic, however, due to the time effects of different lengths of observation period found)

Section 6.1 can be replicated using the VZR data. Tab. 110 shows the applicable analysis conditions and the numbers of cases. It must be noted that the in-depth analyses of Section 6.2.3 cannot be repeated here, because the only control variable present in the VZR data records is the gender of the driver. A distinction is made between silent groups 1 and 2, as these groups represent different durations of solo driving, the rate of accidents falls, but the rate of traffic offences increases over longer periods of time.

The methodological disadvantage that the indicators “VZR accidents” and “VZR offences” are not independent (the latter includes the former) was eliminated to permit independent testing. To this end, the numbers of offences associated with at-fault accidents were substracted from the numbers of all traffic offences to leave non-accident-associated traffic offences only. The resulting indicator was termed “Adjusted VZR offences”. The results are presented in Tab. 111. The effectiveness of the AD17 model was indeed confirmed with this large independent sample: For the “primary evaluation criterion”, the indicator “VZR accidents”, the regression analysis indicated a reduction of 19% in the accident rate for AD17 drivers compared to those obtaining a driving licence in the conventional manner (row highlighted grey).

Sample size	N = 75,117
Data source	VZR data records
Conditions	Selection: Only clearly identified VZR cases (approx. 99%); Counting: Adjusted VZR offences, i.e. only those which were not already taken into account as VZR accidents
Analysis groups	Group 1 (Es1 and Ks1: 27,579) Group 2 (Es2 and Ks2: 47,538)
Analysis period	Group 1 (“long”): approx. 26 months, Group 2 (“short”): approx. 17 months average period of solo driving

Tab. 110: Analysis conditions and numbers of cases

The indicator "Adjusted offences", as the “secondary evaluation criterion”, on the other hand, produces an unexpected result: The previously used regression model, comprising solely main effects without interactions, was incompatible with the data for this indicator (model fit: $p < 0.01$).[102] A just adequate fit ($p = 0.159$) was only achieved when the model was extended to incorporate the interaction of gender and driving licence model. This interaction, however, implies a divergent effectiveness of the AD17 model for male and female drivers with reference to the indicator “Adjusted VZR offences” (at the level of a 1% probability of error).

Separate regression analyses were thus performed for male and female drivers (right-hand columns in

[102] The same is true for the unadjusted indicator (the adjustment to eliminate accident-related records thus cannot be made fundamentally responsible for the incompatibility of the model), albeit to a slightly lesser extent.

Characteristics	Ratios of accidents and traffic offences per 1,000 drivers and year compared to the relevant reference group			
	VZR accidents	Adjusted VZR offences (i.e. excluding at-fault accidents)		
Gender of driver; Female (versus male)	0.52 ***	–	female	male
Analysis group (observation period): Group 1, long (versus Group 2, short)	0.92 n.s.	–	1.29 ***	1.13 ***
Driving licence model: AD17 (versus conventional model) 95% confidence interval	0.81 *** 0.74 – 0.89	–	0.99 n.s. 0.89 – 1.11	0.82 *** 0.78 – 0.87
Goodness of fit of the regression model; Likelihood ratio (chi-squared)	p = 0.703	p = 0.007	p = 0.672	p = 0.586

Legend: n.s. = Difference to parity (1.0) not significant; * = statistically significant ($p \leq 0.05$);
** = statistically very significant ($p \leq 0.01$); *** = statistically highly significant ($p \leq 0.001$); – = calculation not meaningful
Interpretation example: The ratio of the accident rates for female novice drivers compared to their male counterparts is 0.52. This means that the accident risk for female drivers is lower by 48%.

Tab. 111: Period-based risks of accident and traffic offences in the silent analysis groups according to gender, duration of the observation period and driving licence model, based on VZR data

Tab. 111). A highly significant reduction in the rate of traffic offences by 18% for males was confirmed, whereas the reduction for female drivers was only 1% and thus not significant. (The question of a gender-related difference in the effectiveness of the AD17 model is addressed in more detail in the following section.)

In the analysis group covering a longer period, the rate of VZR offences is higher for both male and female drivers compared to the group covering a shorter period. This result was not unexpected, as the rate of traffic offences (contrary to the rate of accidents) at first increases rather than decreases.

Conclusion

The effectiveness of the AD17 model for accidents is replicated on the basis of a large independent sample; the data for this sample were retrieved anonymously from the VZR, as an objective information source, and are thus not subject to self-selection effects relating to survey participation. For traffic offences (excluding accidents), replication is only successful for male drivers, but not for female drivers.

The AD17 model led to a 19% reduction in the number of VZR-recorded accidents per 1,000 drivers and year; the confidence interval ranges from 11 to 26%. For VZR-recorded traffic offences, adjusted to exclude accidents, the reduction achieved by the AD17 model per 1,000 drivers and year among male drivers is 18%, with the confidence interval ranging from 13 to 22%.

These results are independent of any possible internal differentiation relating to the gender of the driver ("Hypothetical effect 2"). They thus exclude the possibility of an overestimation of the (causal) effectiveness of the AD17 model due to the risk-reducing influence of the factor gender. A possible underestimation of the risk-enhancing factor vehicle availability, on the other hand, could not be excluded because this information was not available for the silent analysis groups. In this respect, the (causal) effect of the AD17 model could actually even be slightly greater than was determined here.

103 These are "gross effects", i.e. without deduction of the effects attributable to external variables, e.g. above all to vehicle availability (see Section 6.2.3).

6.3.5 Is the AD17 model equally effective for both male and female drivers?

The results of the previous section could cast doubt on the effectiveness of the AD17 model for female drivers. This question is therefore explored in more depth. The analysis conditions, the number of cases and the data sources used are shown in Tab. 112.

To facilitate identification of any difference in effectiveness, the accidents and traffic offences were counted separately for male and female drivers in the following (Tab. 113). On the basis of this data, it was possible to calculate the subsequently presented rates of accident involvement and traffic offences (Tab. 114). The rows of the table which are highlighted in grey refer to the objective VZR data and are thus directly comparable. The bottom two rows contain mean values. For this purpose, the VZR-recorded offences presented in Tab. 113 for the three analysis groups (contacted groups, silent groups 1 and 2) were cumulated and related to the cumulated years of observation.

Tab. 115 provides an overview of the AD17 effects[103] determined for male and female drivers in the four analysis parts. Here, too, the rows of the table which are highlighted in grey refer to the objective VZR data and are thus directly comparable. The bottom two rows contain mean values calculated from the VZR data.

With reference to the accident indicators, the reduction for AD17 drivers compared to those obtaining a driving licence in the conventional manner is on average 18% for male drivers and on average 23% for female drivers. There is thus no basis for the assumption that the AD17 is less effective among female drivers – on the contrary. With reference to adjusted VZR traffic offences, however, the situation is different: The reduction for male drivers is here on average 18%, but

Data sources	Online questionnaires and VZR data records
Conditions	Selection: Only clearly identified VZR cases (99%)
Analysis groups	Contacted group (18,576), silent group 1 (27,579), silent group 2 (47,538)

Tab. 112: Analysis conditions and numbers of cases

Analysis group	Source	Factor	E groups		K groups	
			Men	Women	Men	Women
Contacted groups (Ek and Kk)		Persons	3,839	4,848	4,555	5,334
		Years	3,836	4,928	4,314	5,192
	Self-reported	Accidents*	402	376	555	493
		Offences	355	227	498	265
	VZR	Accidents	55	22	71	57
		Offences**	154	60	229	73
Silent group 1 (Es1 and Ks1)		Persons	6,570	7,217	7,121	6,671
		Years	13,886	15,241	14,850	13,929
	VZR	Accidents	224	118	278	144
		Offences**	1,009	361	1,289	325
Silent group 2 (Es2 and Ks2)		Persons	12,006	11,781	12,252	11,499
		Years	16,518	16,181	16,610	15,605
	VZR	Accidents	272	150	357	161
		Offences**	1,048	290	1,300	289

* = Accident *involvement* with damage exceeding €1,200 or more or injury to persons or recording by the police;
** = Adjusted VZR-recorded offences (without at-fault accidents)

Tab. 113: Numbers of cases, years of observation and rates of accidents involvement and traffic offences according to analysis group and gender of the driver

Analysis group	Source	Factor	E groups		K groups	
			Accidents and traffic offences per 1,000 drivers and year			
			Men	Women	Men	Women
Contacted groups (Ek and Kk)	Self-reported	Accidents*	104.8	76.3	128.7	95.0
		Offences	92.5	46.1	115.4	51.0
	VZR	Accidents	14.3	4.5	16.5	11.0
		Offences**	40.1	12.2	53.1	14.1
Silent group 1 (Es1 and Ks1)	VZR	Accidents	16.1	7.7	18.7	10.3
		Offences**	72.7	23.7	86.8	23.3
Silent group 2 (Es2 and Ks2)	VZR	Accidents	16.5	9.3	21.5	10.3
		Offences**	63.4	17.9	78.3	18.5
Mean value (from the data of Tab. 113)	VZR	Accidents	16.09***	7.98***	19.74***	10.42***
		Offences**	64.57***	19.56***	78.77***	19.78***

* = Accident *involvement* with damage exceeding €1,200 or more or injury to persons or recording by the police;
** = Adjusted VZR-recorded offences (without at-fault accidents)
*** = Mean values calculated from VZR data only

Tab. 114: Rates of accidents involvement and traffic offences per 1,000 drivers and year according to analysis group and gender of the driver (results highlighted grey based on objective VZR data)

for female drivers on average only 1%. In the silent analysis groups, in particular, practically no AD17 effect was found for female drivers. But even in the contacted group, Tab. 115 shows that the AD17 model is only half as effective for female drivers as for male drivers with reference to traffic offences, namely 10% reduction compared to 20% according to the self-reported data, and 13% compared to 24% according to the VZR data.

If Poisson regressions are performed with the adjusted VZR offences exclusively for female drivers in the different analysis groups, the driving

Group	Source		Men	Women
Contacted group (Ek vs. Kk)	Self-reported	Accidents*	-19%	-20%
		Offences	-20%	-10%
	VZR	Accidents	-13%	-59%
		Offences**	-24%	-13%
Silent group 1 (Es1 vs. Ks1)	VZR	Accidents	-14%	-25%
		Offences**	-16%	+ 2%
Silent group 2 (Es2 vs. Ks2)	VZR	Accidents	-23%	-10%
		Offences**	-19%	- 3%
Mean value	VZR	Accidents	-18%***	-23%***
		Offences**	-18%***	-1%***

* = Accident *involvement* with damage exceeding €1,200 or more or injury to persons or recording by the police;
** = Adjusted VZR-recorded offences (without at-fault accidents);
*** = Mean values calculated from the mean values in

Tab. 115: Percentage reduction in the rates of accidents and traffic offences per 1,000 drivers and year for AD17 drivers compared to drivers obtaining a conventional driving licence according to analysis group and gender

licence model does not reach significance as a factor in any of the cases[104].

Fig. 34 and Fig. 35 provide an overview of the rates of VZR-recorded traffic offences for male and female drivers on the basis of the mean values calculated over all analysis groups (see bottom two rows of Tab. 114). The figures reveal an already impressively low rate of VZR offences for young female drivers (Fig. 35), which cannot be reduced further by the AD17 model.

Conclusion

With reference to accidents, the primary evaluation criterion, there is no evidence of a reduced effectiveness of the AD17 model for female drivers.

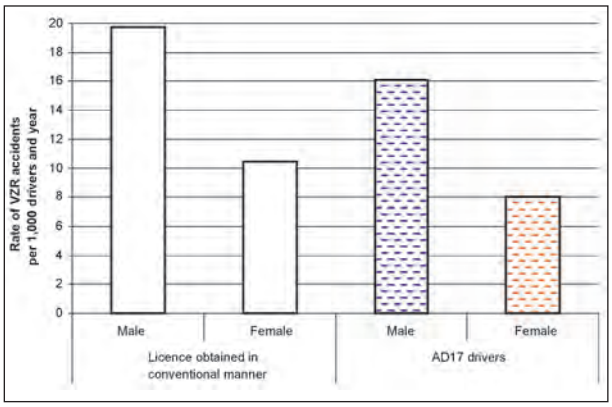

Fig. 34: Rates of VZR accidents for male and female AD17 drivers and drivers obtaining a conventional driving licence per 1,000 drivers and year

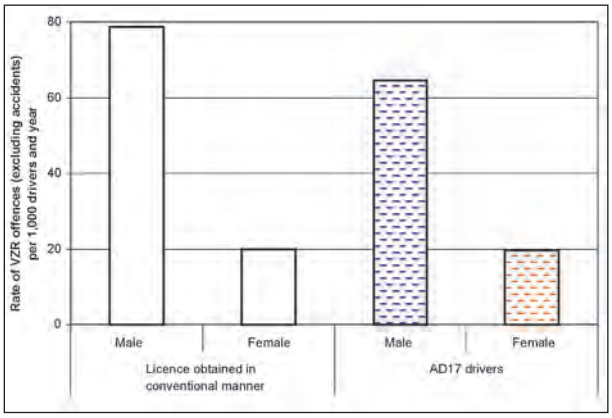

Fig. 35: Rates of adjusted VZR offences (i.e. excluding at-fault accidents) for male and female AD17 drivers and drivers obtaining a conventional driving licence per 1,000 drivers and year

The secondary evaluation criterion, however, shows practically no effects for female drivers: The available sample size does not permit detection of a similarly positive effect of the AD17 model on the rate of traffic offences for female drivers. However, the rate of traffic offences for female drivers who obtained a driving licence in the conventional manner is already lower than that of their male counterparts by three-quarters (Tab. 114); there is thus no serious problem to be solved by the AD17 model in this respect.

6.3.6 Does the AD17 model produce a lasting effect?

It was already demonstrated that the effectiveness of the AD17 model is more than just a passing effect lasting a few weeks or months. On the other hand, measures intended to influence behaviour cannot be expected to achieve a generally lasting effect[105] without regular

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104 p(one-sided) = 0.128 for the self-reported data of the contacted group; p(one-sided) = 0.201 for the VZR data of the contacted group; p(one-sided) = 0.451 for the VZR data of the combined silent groups. Other than to the reduced effectiveness of the AD17 model for female drivers, this could also be due to the insufficient sensitivity of the present analysis design for this particularly demanding case. The analysis design was conceived to reveal statistically significant AD17 effects of the order of at least 15 per cent. The intention of the analyses in this section, namely to detect a much smaller effect for the subset of female drivers, goes far beyond the original requirements; this subset is furthermore already characterised by a very low basic rate of traffic offences.

105 A limited effect is by the way a factor which could support the notion of causality of a measure (see Section 6.2.6).

refreshment. The question is thus: How long does the AD17 effect prevail?

Tab. 116 shows the applicable cases and analysis conditions. As it is necessary to consider the longest possible period after the start of solo driving, only silent group 1 is considered in each case.

Fig. 36 and Fig. 37 present the development over the first 24 months in eight quarters, separately for the groups Es1 and Ks1. Two significant aspects are apparent:

Sample size	N = 27,579
Data source	VZR data records
Conditions	Selection: Only clearly identified VZR cases (approx. 99%)
Analysis groups	Es1 group (13,787) Ks1 group (13,792)
Analysis period	First two years of solo driving

Tab. 116: Analysis conditions and numbers of cases

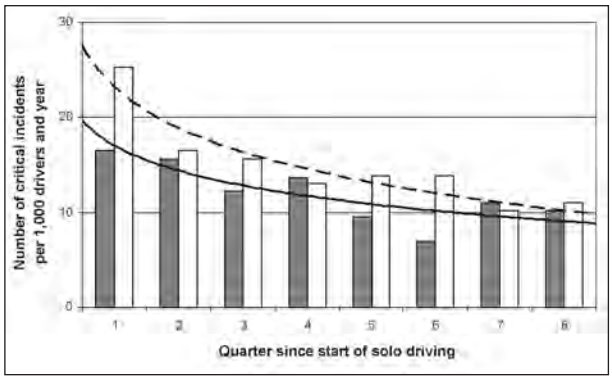

Fig. 36: Rates of car-related VZR accidents since the start of solo driving per 1,000 drivers and year for AD17 drivers (grey bars) and those obtaining a conventional driving licence (white bars)

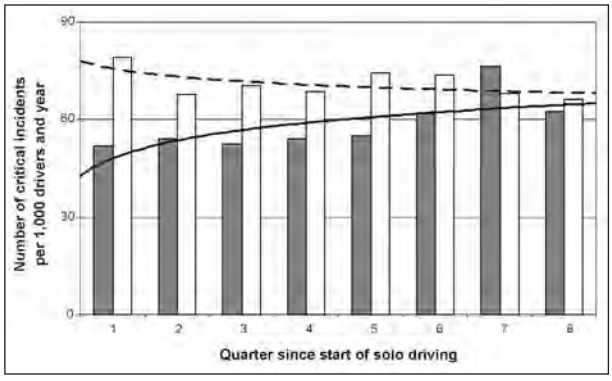

Fig. 37: Rates of car-related VZR-recorded traffic offences (including accidents) since the start of solo driving per 1,000 drivers and year for AD17 drivers (grey bars) and those obtaining a conventional driving licence (white bars)

- Whereas both the accident rate and (to some extent) the rate of VZR offences decrease over time for drivers who obtain a licence in the conventional manner, this is only true of the accident rate in the case of AD17 drivers. The rate of VZR offences even increases slightly in this group.
- Irrespective of their individual development during the period of observation, the rates for AD17 drivers and conventional licence holders approach each other to such an extent over time, that no substantial difference remains at the end of the second year; this is the case for both indicators.

GREGERSEN et al. (2000) also reported a strong accident-reducing effect over at least two years in their evaluation of the Swedish accompanied driving model. As explained in Section 1.2, however, their depiction (Fig. 3, p. 31) suggests a very low accident rate close to zero after two years of solo driving.

The first months after obtaining a driving licence are known to entail a greatly increased risk of accident involvement, though this risk subsequently decreases rapidly, also independently of any supporting measures: In-house studies (SCHADE, 2001) indicate that the portion of risk which is influenced by experience is reduced by approx. 90% after some two-and-a-half years of driving practice (not taking into account a sizeable “socially accepted residual risk”). As shown by data on official accident statistics, specifically also for the group of early beginners addressed here (WILLMES-LENZ, 2002), this impressive learning process is only displayed in respect of at-fault accidents (solid line in Fig. 38), whereas the frequency of accident involvement without main responsibility for the accident remains practically unchanged (dashed line)[106]. The (at-fault) VZR accidents in Fig. 36 are thus qualitatively comparable with the course of the dashed line in Fig. 38. The figures reveal the characteristic properties of the transition into participation in motorised road traffic: The initially high risk on the

106 This constancy in the figures for accident involvement without principal fault over the first years of driving practice is furthermore an impressive rejection of the hypothesis that novice drivers are also indirectly jointly responsible for many other accidents due to their hesitant, unpredictable and unsure driving behaviour.

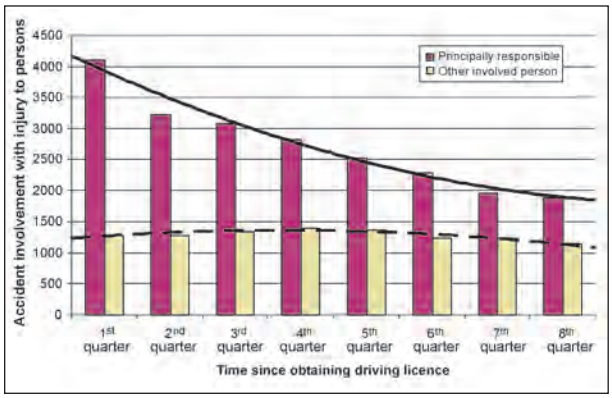

Fig. 38: Involvement of novice drivers with a driving licence obtained in the first quarter after their 18th birthday ("early beginners") in accidents with injury to persons in 2000, differentiated by their role as the principally responsible person for the accident or other involved person (based on data from WILLMES-LENZ, 2002, Tab. 14); trend lines: 2nd order polynomial

one hand, and the subsequent extensive reduction of this above-average risk during the first two years of solo driving practice.

Conclusion

The effect of the AD17 model appears to be limited essentially to the first two years of solo driving, and thus precisely to the important transitional phase of participation in motorised road traffic. This is also the phase in which key challenges are to reduce the initial risk and to optimise the acquisition of driving competence.

6.3.7 How is the AD17 effect reflected in the official accident statistics?

The Federal Statistical Office reported on the development of accident figures for young drivers in Germany (2009b, p. 32): "Compared to 2007, the number of 18 to 24-year-old road accident casualties dropped by 6.5%. 2008 was the eighth year in succession in which the number of persons killed in this age group declined, namely by 8.7% last year. This positive development concerned predominantly vehicle users. Compared to 2007, the number of 18 to 24-year-olds killed in car accidents fell by 104 persons or 14%. This age group thus recorded the biggest drop in vehicle users killed. If 18 to 20-year-olds are viewed separately, it is apparent that the drop is predominantly attributable to these younger novice drivers (-19% or 84 persons). At the same time, the number of persons principally responsible for an accident dropped more distinctly among novice drivers (7.2%) than on average across all age groups (5.1%). The analyses to be performed by the Federal Highway Research Institute on behalf of the Federal Ministry of Transport will show whether these results can be interpreted as success of the now nationwide trials with the 'Accompanied Driving' model."

It is difficult, however, to attribute the aforementioned effects to the AD17 model beyond reasonable doubt; this is explained in the following. All statements made here regarding the AD17 model could lead to the expectation that the official accident figures for young novice drivers should drop significantly during the phase of introduction of the AD17 model, namely above all in the years 2005 to 2008. Rough estimations[107], however, show that such expectations are exaggerated:

The generally available tables of official accident statistics define young drivers as 18 to 20-year-olds. Within this group, the 18 and 19-year-olds (the ages relevant for an AD17 effect assumed to be limited to two years) represent a share of roughly two-thirds. Of these 18 and 19-year-old drivers, in turn, only a small proportion belong to the group to be analysed here, namely the novice drivers who obtain a driving licence during the first quarter after their 18th birthday. These young novice drivers are estimated to account for only one-third of the driving by 18 and 19-year-olds. In the years under consideration, finally, between one and two-thirds of the young novice drivers participated in the AD17 model; the average participation was around 50%.

If the aforementioned percentages are multiplied with the effect of a reduction in accidents by 19% (according to Tab. 111), this produces a value of a little over two per cent. This is thus the order of the reduction which should become visible in the official accident statistics for 18 to 20-year-old drivers in the period under observation. It is not easy to demonstrate such small changes, however, especially as the change does not occur suddenly, but instead spreads over several years. Furthermore, it is superimposed by already long-standing trends in the accident figures for young adults, by the effects of other measures addressing novice drivers and by annual fluctuations.

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107 The exact figures are not initially important, as even a much more favourable estimation would have no effect on the conclusion.

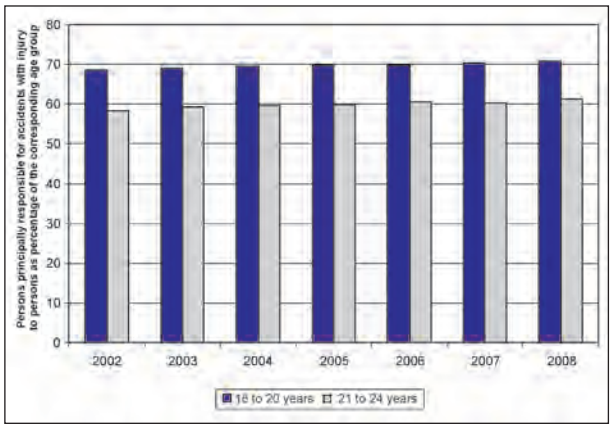

Fig. 39: Proportions of principally responsible persons as a percentage of all drivers involved in accidents with injury to persons in the corresponding age group

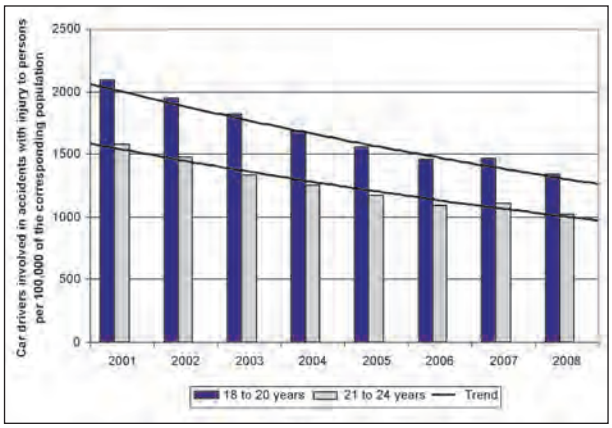

Fig. 40: Involvement as driver in injury accidents per 100,000 of the corresponding population

To this end, the development of two accident parameters was analysed for the 18 to 20-year-old and 21 to 24-year-old drivers. Fig. 39 shows the proportions of principally responsible persons as a percentage of all drivers involved in accidents with injury to persons in each age group. Both for the group of 18 to 20-year-olds[108] and for the group of 21 to 24-year-olds, a slight trend towards a higher proportion of principally responsible persons can be recognised over the years. The differences in the changes of these figures between the age groups, however, are marginal. It is in particular not possible to derive a lesser increase in the younger age group, which could be attributed to the positive influence of the AD17 model.

Another accident parameter of high significance is the involvement in accidents with injury to persons per 100,000 of the corresponding population. This parameter displays a strong decline over the past seven years (Fig. 40). But here, too, the relative difference between the age groups remains practically constant over the whole period: The rate of involvement is in each year very exactly one-third higher in the group of 18 to 20-year-old drivers than in the group of 21 to 24-year-old drivers.

The increased demand described in Section 5.1 may have contributed to the absence of a clear reduction in accidents. If this slight increase in the demand for driving licences, which was found among young drivers under 19 years of age after introduction of the AD17 model, were proven to be a sustained effect (not yet confirmed at the time of writing), it could be expected that their accident figures would increase.

It is unclear, however, to what extent the total number of accidents in the population would increase as a consequence. An increase in demand does not necessarily mean that driving is extended into new population groups which would never have considered obtaining a driving licence without the AD17 model. The increased demand among young drivers under 19 years could also result simply from a shift forward to an earlier date (a shift forward by only a few weeks or months appears plausible, however; this would then have only a minor impact on the accident figures for 18 and 19-year-olds.) It remains unclear, therefore, why no convincing AD17 effect is displayed in the accident statistics.

But even without the support of the official accident statistics, it should be possible to quantify the accident reduction attributable to the AD17 model in absolute figures. The assumption that the general 17% reduction in accidents during the first two years of solo driving (after adjustment for internal differentiation effects) is equally applicable to the subset of accidents with injury to persons, leads to the following figures and considerations:

1. The relative change Δ in the accident rate AR (per 1,000 drivers and year) during the first two years of solo driving, i.e. at the ages of 18 and 19 years, is 17 per cent for drivers who have participated in the AD17 model, after adjustment for the effects of internal differentiation. This change is relative to those persons who obtain a driving licence in the conventional manner.

108 A more targeted analysis specifically for 18 and 19-year-old driving licence holders also fails to produce more distinct results (Tab. 3.11.2 of the official accident statistics, Statistisches Bundesamt, Fachserie 8, Reihe 7).

2. According to own research, there were 0,510 million drivers aged 18 or 19 who had previously participated in the AD17 model at the beginning of 2009; at the end of the year, this figure reached 0.580 million, representing an average of around 0.545 million. By comparison, there were approx. 1.090 million holders of a car driving licence aged between 18 and 19 years at the beginning of the same year; at the end of the year, their figure was around 1,110 million, representing an average of around 1,100 million. The overall group of 18 to 19-year-old drivers in 2009 was thus divided very exactly into one half with AD17 experience and one half without AD17 experience. The overall change in the accident rate can thus be calculated as follows:

$$\Delta_{total} = 0.5 \cdot \Delta_{with} + 0.5 \cdot \Delta_{without}$$

As $\Delta_{without}$ is set to zero, the overall change is -8.5 per cent.

3. In 2009, there were 18,479 cases of injury accidents where an 18 to 19-year-old driving licence holder was the principally responsible person (Statistisches Bundesamt, 2009a). Related to the total of 1.100 million drivers, this produces an accident rate AR of 16.8 accidents per 1,000 drivers and year.

4. This overall rate can be designated AR_{new}, because it reflects the accident-reducing AD17 effect; the question is then, how high would the accident rate have been without the effect of the AD17 model, namely AR_{old}?

$$\Delta_{total} = \frac{AR_{new} - AR_{old}}{AR_{old}} \cdot 100$$

can be rearranged as

$$AR_{old} = \frac{100}{100 + \Delta_{total}} \cdot AR_{new}$$

If AR_{new} = 16.8 and Δ_{total} = -8.5, this produces a value of 18.36 for AR_{old}.

5. A rate of 18.36 accidents per 1,000 drivers and year for a total of 1.100 million driving licence holders (see point 2) produces a total of 20,196 accidents during the year; in other words, 1,717 more than actually counted. (Test: A reduction by 1,717 accidents for a total of 20,196 means a change by -8.5%.)

Without the 17% reduction in accidents attributable to the AD17 model, therefore, there would have been over 1,700 more injury accidents caused by young drivers in 2009.

Conclusion

The reduced accident rate of AD17 drivers, although demonstrated beyond reasonable doubt, is not clearly reflected in the tables of official accident statistics. Closer analysis, however, shows that this was scarcely to be expected due to the small numbers involved. In absolute figures, it can be calculated that around 1,700 accidents with injury to persons were prevented by implementation of the model in 2009.

7 Summary

7.1 Questions addressed

The objective of the summative evaluation was to determine whether the introduction of the model “Accompanied driving from age 17” (AD17) contributed as hoped to an improvement in road safety and compliance with traffic rules. To this end, data on traffic accidents and traffic offences were analysed. Three conceivable effects following the implementation of the AD17 model were tested as hypotheses:

1. The AD17 model may stimulate increased demand for driving licences in the youngest age groups and thus expand the at-risk population of 18-year-old drivers (Hypothetical effect 1). This would have negative consequences for road safety and for the compliance with traffic rules.

2. The AD17 model may lead to internal differentiation into higher- and lower-risk drivers within the relevant target group of “early beginners”, defined as those drivers who obtain their driving licence during the first quarter after their 18th birthday (Hypothetical effect 2). In this case, there would be no gain for road safety and for the compliance with traffic rules.

3. AD17 experience exerts direct positive influences on road safety and on the compliance with traffic rules by participating drivers (Hypothetical effect 3).

The three effects may be found superimposed.

7.2 Methods

Testing of the first hypothesis required data to be retrieved from the Central Register of Driving Licences (ZFER) held at the Federal Motor Transport Authority (KBA), while testing of the second and third hypotheses used data on accident involvement and traffic offences from questionnaires and from the Central Register of Traffic Offenders (VZR). The calculation of figures from the ZFER records is not explained in further detail here; the following method descriptions thus refer solely to the testing of the second and third hypotheses.

Analysis plan

The evaluation comprises survey and replication studies. In addition to "contacted analysis groups" who were asked to complete a survey questionnaire, "silent analysis groups" were also formed. The latter were not contacted; instead, the VZR was consulted at the end of the observation phase of accompanied driving to retrieve data records relating to potential traffic offences. This served to control for possible self-selection and observation effects, to analyse the generalisability of findings in the contacted groups, and to replicate the findings with independent samples.

Within the contacted and silent analysis groups, two subsets were compared: Former AD17 drivers who had participated in accompanied driving for at least three months, and novice drivers of the same age who had obtained a driving licence in the conventional manner during the first quarter after their 18th birthday.

The evaluation refers to the driving behaviour of novice drivers (measured by traffic offences and traffic accidents) during the first one to two years of solo driving with a car.

Recruitment of the analysis groups

The drivers of the aforementioned groups were drawn randomly from the ZFER register, including drivers from eleven federal states which had been participating in the model for at least twelve months on the reference date. The population for the sampling comprised all those persons from these federal states who had received a driving licence for vehicle class B or BE at an age between 18 years and 18 years and three months during certain months of the year 2007, irrespective of possible AD17 participation (here referred to as "early beginners"). Stratification of the samples ensured that the places of residence of the selected persons corresponded to the numbers of driving licences issued in the participating federal states.

Silent analysis groups

A first random sample of drivers who commenced solo driving at the beginning of 2007 was drawn from the ten federal states which had been participating in the model for at least twelve months on the reference date. This sample comprised both AD17 participants and drivers who obtained a driving licence in the conventional manner. The period of observation was 24 months. A second random sample for both groups, with commencement of solo driving from the end of 2007, covered persons from eleven federal states and an observation period of 15 months.

For the silent groups, all VZR records relating to traffic offences penalised with a fine of at least €40 were retrieved for the 12-month period before the start of solo driving and for the relevant observation period of 15 or 24 months of solo driving. The analysis considered all traffic offences and distinguished between offences in connection with an at-fault accident and other offences.

Contacted analysis groups

The contacted analysis groups were contacted by post and asked to complete an online questionnaire. Persons without Internet access could ask to be posted a paper version. To ensure optimum coverage of the period of solo driving, an intermediate survey was included between the initial survey (on average after 7 months) and the final survey (on average after 14 months) where there would otherwise have been an excessively long gap between questionnaires.

Extensive data were collected for the contacted analysis groups on socio-demographic background, driving practice, driving behaviour and any accidents or traffic offences. All accident involvement was taken into account, irrespective of the degree of fault on the part of the novice driver, insofar as police recording of the accident, estimated damage of at least €1,200 or injury to persons was reported ("significant accidents"). At the same time, all traffic offences penalised with a fine of more than €25 were considered ("significant traffic offences").

In addition, on the basis of granted consent, data records were retrieved from the Central Register of Traffic Offenders (VZR) for each driver, namely for the periods of exactly one year before and at least 12 months after the start of solo driving.

Statistical approach

So-called Poisson regressions were used to predict the dependent variable, namely the frequency of traffic accidents and offences, on the basis of the independent variable, namely the choice of driving licence model (AD17 versus conventional model). Further independent variables, such as gender or vehicle availability, were taken into account where it was necessary to control for their influence on driving behaviour. A statistical test determined the significance of each influencing factor, independently of all other influencing factors. In this way, it was possible to test whether choice of the AD17 model exerted a significant influence on the number of accidents or traffic offences independently of driver gender or vehicle availability, for example. In the end, the result served to confirm or reject the effectiveness hypothesis in respect of AD17.

7.3 Sample quality

To be able to assess the significance of the study results, it is necessary to verify the quality of the achieved samples.

Silent analysis groups

A total of 114,000 years of solo driving practice accumulated by approximately 75,000 young novice drivers was available for analysis in the replication study based on the random samples forming the silent analysis groups; half of this driving practice related to AD17 participants. In addition, approximately 75,000 years of observation from the twelve months prior to solo driving were considered. The achieved sample sizes were suitable for the planned replication of the results obtained for the contacted analysis groups.

Contacted analysis groups

The written requests, reminders and prize draw announcements led to an overall participation rate of 34%. Approximately 44 per cent of the AD17 drivers and 25 per cent those who obtained a driving licence in the conventional manner completed the initial online questionnaire. Of these, 70% participated in the intermediate survey and 67% in the final survey. Overall, the completed questionnaires reflect the experience of a representative sample of approximately 8,800 AD17 drivers and 10,000 drivers who obtained a driving licence in the conventional manner. The analysis takes into account a total of more than 18,000 years or almost 150 million kilometres of driving practice, gained during an average observation period of almost 14 months. The sample sizes and observation periods required for a statistical outcome evaluation were thus met.

The percentage deviations from the target sample sizes for proportional representation of the participating federal states generally remained in single figures. There was no difference in the participation between rural areas and the towns and cities. Different rates of participation of male and female respondents, however, led to a slight distortion in the net sample: Instead of the required proportion of 51% male drivers, only 45% responded. Consequently, it became necessary to include gender as a control variable in the evaluation, particularly since gender is known to correlate closely with road traffic participation and traffic offences. Persons with higher educational attainment were also slightly over-represented compared to other equivalent studies.

Bias due to differences between the samples of AD17 participants and conventionally trained drivers

The AD17 drivers reported higher educational attainment compared to those who obtained a driving licence in the conventional manner. The difference of five percentage points is statistically significant but still small. The differences between the two analysis groups with regard to gender and the regional structure of their place of residence were similarly significant, but also even smaller.

Bias due to the exclusion of respondents without Internet access

Ninety-two per cent of the contacted persons who completed the initial questionnaire used the Internet to do so. Despite certain systematic differences between the users of the online and paper

questionnaires, the decision to exclude survey respondents without Internet access did not significantly affect the sample composition. There is in particular no sample bias between the analysis groups with and without AD17 participation.

Bias due to the announcement of incentives

It was necessary to announce "incentives" in order to attract sufficient numbers of volunteer survey respondents. The change in sample composition following the (very effective) announcement of incentives was significant for a number of variables, but still small in terms of absolute extent: A pre-post comparison revealed shifts of only three to five percentage points. Some factors were actually shifted in a desirable direction: The incentives attracted the participation of more male respondents, more persons with lower educational attainment and more persons with a driving licence obtained in the conventional manner, in other words groups which would otherwise have been slightly under-represented. When all variables are taken into account, no sample bias could be identified between the analysis groups with and without AD17 participation as a result of the announcement of incentives.

Bias due to survey drop-outs

The change in sample composition attributable to the premature termination of survey participation was significant for a number of variables, but still small in terms of absolute extent.

Bias due to self-selection for AD17 participation

Contrary to a laboratory-based experiment, it was not possible to allocate participants randomly to the two analysis groups (participants in the AD17 model and conventionally trained drivers). This means that self-selection effects must be expected and may overlap with the effects of the driving licence model. Apart from the already described difference between the compared groups, namely a tendency to higher educational attainment in the group of AD17 drivers, there were further small differences, for example a tendency for greater driving practice among AD17 drivers. The impact of these differences is only slight, but they must nevertheless be taken into account when interpreting the results.

7.4 Results pertaining to AD17

Acceptance of the model

In 2008 and 2009, once all federal states had introduced the pilot scheme, around 300,000 young drivers participated in the AD17 model each year. By the end of 2009, almost one million young drivers had participated successfully in the AD17 model since its introduction in Germany.

The AD17 model is thus gradually superseding the conventional form of driver training among early beginners. Towards the end of 2009, around three-quarters of all early beginners, i.e. those persons obtaining a driving licence up to the end of the first quarter after their 18th birthday, opted for the AD17 model. Consequently, more than one-third of all novice car drivers in Germany participated in the AD17 model in 2009.

Reasons for not participating in the AD17 model

If personal reasons (other priorities) and lack of information are excluded, the only remaining "external reasons" are the various lacking prerequisites mentioned by 37% of the respondents. In two-thirds of these cases, the necessary money was lacking; to a large extent that overlapped the one-third of cases in which no vehicle was available. A further one-third of the respondents did not have a suitable accompanying passenger, though this was due to lacking legal prerequisites in only 44% of the cases. The present legal barriers for the accompanying passenger do not appear to hinder participation particularly, as only 6.2% of all respondents specified this reason. Among the external factors, it is thus above all financial reasons and the lack of a vehicle which act restrictively (mentioned as the reason for not participating by 12.5% of all respondents).

Factors for a decision in favour of the AD17 model

The following influences were identified as significant determinant factors for a decision in favour of the AD17 model: Higher educational attainment, rural place of residence and the availability of a second or further vehicles in the household. The effect sizes, however, are small or even very small according to statistical convention. This means that the choice of driving licence model is hardly determined by these factors, and is

essentially dependent on other circumstances. General personality traits, where analysed, appeared to play no role in decision-making.

The accompanied driving phase

The chosen accompanying passenger was almost exclusively a parent, namely in 97 per cent of cases. Consequently, the most commonly used vehicle was the parent's vehicle. This underlines the importance of parental support for the AD17 model. The age and engine power of the primarily used vehicles follows the corresponding proportions of all vehicles registered in Germany very closely.

As expected, the rates of self-reported involvement in accidents and traffic offences were low at around 5%, if minor damage in connection with parking is excluded. The rate of VZR-recorded traffic offences was lower still, namely below one per cent.

With regard to the intended purpose of the AD17 model, it is critical that around two cent of the novice drivers had no vehicle available during the accompanied driving phase and were thus unable to gather driving practice. The intensity of driving practice was also less than satisfactory in the approx. 25% of cases where participants reported one hour or less of driving per week. More than 10% of the young drivers never used motorways during their accompanied driving. Overall, according to the retrospective self-reporting, around 50% of the male drivers and around 60% of the female drivers failed to reach even the modest threshold of 1,000 kilometres of accompanied driving practice. This high rate may be partially due to the very short accompanied driving phase of less than six months reported by many drivers. In fact, the rate would presumably be even higher if the AD17 participants not considered by the present study, namely those with an accompanied driving phase less than three months, were also to be taken into account.

Vehicle use in the first year of solo driving

Some 4% of the former AD17 participants and 9% of the drivers with a licence obtained in the conventional manner did not (yet) have a vehicle available for their use in the first months of solo driving. Apart from this group, the unusually high level of vehicle availability in the households of young novice drivers was remarkable. During this period, compared to accompanied driving phase, the young drivers were more frequently the principal or even exclusive user of the available vehicle and more frequently themselves the vehicle owner. The engine power of the vehicles used was significantly below the German average, but the vehicles were not older. Driving practice during the first months of solo driving remained moderate: Extrapolation of the reported practice produced a mean annual distance driven of 8,500 km.

Compared to persons who obtained their driving licence in the conventional manner, former participants in the AD17 model were more frequently the principal user or even the owner of the vehicle used; the engine power of the vehicle used more frequently exceeded 50 kW, and the vehicle was less frequently more than nine years old. Former AD17 drivers more frequently spent more than four hours driving and also more frequently drove more than 200 km per week.

These differences between the (former) AD17 drivers and those who obtained their driving licence in the conventional manner are not attributable to the factors gender, educational attainment or place of residence (urban/rural). Whilst the differences are significant, they are of little practical relevance.

7.5 Answers to the central questions of the summative evaluation

In the following, the central questions regarding the effectiveness of the AD17 model will be answered, thereby confirming or rejecting the three formulated hypotheses (see section 7.1).

Effect on the demand for driving licences

Even though the demand for the AD17 model increased only slowly during the phase of introduction from 2005 to 2008, its acceptance within the population was in the end remarkably high: By the end of the period of pilot implementation on 31.12.2010, approx. 1.3 million young drivers had participated successfully in the AD17 model since its introduction in Germany.

Despite the great success, the increase in demand for driving licences from persons under 19 years of age increased by only five per cent relative to the overall population during the phase of introduction. Almost all AD17 participants, therefore, would have obtained a driving licence during the first three

months after their 18th birthday even without the possibilities offered by the AD17 model.

The slight increase in demand seems to confirm the first hypothesis of increased "early exposure" to road traffic as a consequence of the AD17 model. There are indications, however, that the higher demand is only a temporary effect, perhaps because the initially increased interest declines once the AD17 is viewed by the public as a normal procedure.

Results of the survey study

On the basis of self-reported driving behaviour relating to the first year of solo driving, it was shown that in the group of approx. 9,000 contacted AD17 participants

- the rate of accident involvement per 1,000 drivers and year was 19 per cent lower, and
- the rate of traffic offences per 1,000 drivers and year was 18 per cent lower

compared to the contacted group of approx. 10,000 drivers who obtained their driving licence in the conventional manner (Tab. 117).

As the study addresses particularly the influence of the AD17 model on driving competence, a kilometre-based comparison is expedient (per million kilometres driven): On this basis, the comparison between the group of AD17 drivers and those who obtained their driving licence in the conventional manner revealed even greater reductions, namely

- a rate of accident involvement lower by 23 per cent and
- a rate of traffic offences lower by 22 per cent.

For the results of the survey to be interpreted as evidence for the success of the AD17 model, they must be subjected to critical methodical evaluation, including replication for a larger, independent sample; this is described in the following.

Critical methodical evaluation

The aforementioned differences with regard to both accident involvement and traffic offences are statistically significant at the level of a 1% probability of error.

The two random samples of young drivers and likewise their respective observation conditions are comparable; the results obtained for the eleven federal states which participated during the pilot implementation of the model are representative.

It was possible to dismiss the objection that the results were distorted by the data of premature drop-outs. The further challenge that the effectiveness of the AD17 model could be a merely temporary effect following on from the long and intensive phase of accompaniment was similarly refuted: The effect of the AD17 model is at least as high in the second six months of solo driving as in the first six months.

The objection that the AD17 model results merely in an internal risk differentiation between the analysis groups (Hypothetical effect 2), and that this is in part responsible for the observed differences, cannot be rejected unequivocally: The slightly higher proportion of female drivers in the AD17 group does indeed improve the positive results for this group by a few percentage points. At the same time, however, the actual causal effect of the AD17 model is underestimated by a few percentage points due to the greater vehicle availability among AD17 drivers.

When both distorting influences are taken into account, and after further adjustment of the results for the influence of educational attainment, the period-based comparison (per 1,000 drivers and year) leaves a reduction in accidents by 17 per cent and a reduction in traffic offences by 15 per cent as a causal effect (Hypothetical effect 3). In the kilometre-based comparison (per million kilometres driven), the reduction is 22 per cent in the case of accidents and 20 per cent for traffic offences (see overview in Tab. 117). The positive effect of the AD17 model on the driving behaviour of "early beginners" thus cannot be attributed simply to internal differentiation into high and low risks in the sense of "Hypothetical effect 2", as the factors with risk-reducing and risk-enhancing effects for road safety within the AD17 group are not particularly pronounced and also cancel each other out to a large degree.

At the same time, several indicators support a causal effect of the AD17 model on driving safety and driving behaviour in the sense of Hypothetical effect 3. A dose-response relationship exists: The rates of accidents and traffic offences during the phase of solo driving decrease with increasing driving practice, measured in kilometres, during the

accompanied driving phase. The effect also fades with increasing time since accompanied driving. The results indicate the effect to be highly specific: The AD17 model remains practically ineffective with regard to accidents and traffic offences of minor relevance (bagatelle incidents), but exerts an ever stronger effect with increasing severity of the incidents.

In view of potential criticism regarding the validity of self-reported behaviour, the results obtained were supplemented by an evaluation of data records held in the Central Register of Traffic Offenders (VZR). The testing of effectiveness on the basis of these objective data on driving behaviour fully confirmed the effectiveness of the AD17 model determined on the basis of survey responses.

To clarify the potential distorting influence of self-selection for participation in a voluntary survey study, the results obtained were compared with those of silent analysis groups, i.e. persons who were unaware of their (anonymous) participation. This comparison demonstrated that those who agreed to take part in the survey (self-selection) already displayed an approximately one-third lower rate of accidents or traffic offences. At the same time, however, the AD17 model was also somewhat more effective in their case compared to the anonymous group (see remarks on the replication study below). This slightly increased effectiveness among the volunteer survey participants could be a result of the considerable self-selection effect in this group and their knowledge of being under observation. This objection can only be rejected with the results of a replication study.

Reduction in the rates of accident involvement and traffic offences, measured ...	Involvement in significant accidents*	Traffic offences penalised by fine over €25
Result without adjustment		
... per 1,000 drivers and year	-19%	-18%
... per million kilometres driven	-23%	-22%
Result after adjustment for internal differentiation (gender, educational attainment, vehicle availability)		
... per 1,000 drivers and year	-17%	-15%
... per million kilometres driven	-22%	-20%
* Damage from €1,200 or injury to persons or recording of the accident by the police		

Tab. 117: Overview of the survey study results: Reduction in the rates of accident involvement and traffic offences during the first year of solo driving for AD17 participants compared to drivers obtaining a licence in the conventional manner

Replication study

Decisive questions for the study were thus whether the results obtained on the basis of survey data could be replicated independently, and whether the observed effectiveness of the AD17 model relating to the voluntary survey participants could also be applied to analysis groups which were not affected by any self-selection effects relating to survey participation. An initial period of on average 20 months of solo driving was analysed for a large independent sample of over 75,000 young drivers on the basis of objective VZR data records. This revealed that the rate of at-fault accidents per 1,000 drivers and year was 19 per cent lower for former AD17 participants (confidence interval 11 to 26 per cent).

The German AD17 model thus displays a generally smaller effect than the 24 to 40 per cent reduction in accidents reported by GREGERSEN et al. (2000) for the Swedish model of accompanied driving with its reduction of the age for the commencement of driver training from 17.5 to 16 years.

For male AD17 drivers, the reduction in VZR-recorded traffic offences, excluding accidents, per 1,000 drivers and year was 18% (confidence interval 13 to 22 per cent). In the case of female drivers, by contrast, the reduction of only one per cent was unable to provide statistically founded proof of effectiveness. On the other hand, the rate of traffic offences for female drivers who obtained a driving licence in the conventional manner is

Reduction in accident involvement and traffic offences, measured as...	VZR-recorded accidents with considerable degree of fault	VZR-recorded traffic offences without at-fault accidents
Rate per 1,000 drivers and year	-19%	-18% for males -1% for females

Tab. 118: Overview of the replication study results: Reduction in the rates of accident involvement and traffic offences during an initial period of on average 20 months of solo driving for AD17 participants compared to drivers obtaining a licence in the conventional manner

already lower than that of their male counterparts by three-quarters; there is thus no serious problem to be solved by the AD17 model in this respect. It must be noted, however, that there is no indication of a reduced effectiveness of the AD17 model with regard to the accident involvement of female drivers.

The data for one of the analysis groups permitted the effect of the AD17 model to be tracked over a period of 24 months. It was shown that the effects decrease noticeably at the end of the first two years of solo driving. Consequently, the figures presented here can only be related to at most the first two years of solo driving, i.e. to drivers aged 18 and 19 years. This, however, is also the phase in which an increased novice risk places particular demands on risk prevention measures (WILLMES-LENZ, 2002).

Extended topics of the evaluation

There is no evidence to support the notion that a female accompanying passenger enhances the effectiveness of the AD17 model. The same applies to the age of the accompanying passenger. Accidents and traffic offences recorded during the accompanied driving phase, however, lead to a significantly poorer prognosis for future solo driving behaviour. This applies to almost six per cent of the novice drivers, for whom the effectiveness of the AD17 is practically outweighed.

One potentially critical side effect of the AD17 model is that the participating 17-year-olds are permitted to use a moped without being required to obtain a corresponding licence, and that this could lead to an increase in moped-related accidents and traffic offences. This objection was not substantiated: It was not only that the rates of accidents and traffic offences for AD17 drivers and for persons obtaining a driving licence in the conventional manner were very low. The differences between the groups were also too small to be statistically significant.

The possible argument that the accompanied driving phase merely shifts accident involvement and traffic offences into an earlier period, but does not lead to an overall reduction, can be rejected on the basis of the VZR data for the silent analysis groups: To this end, the relevant incidents involving AD17 drivers were compared to those involving conventionally trained young drivers for the months immediately prior to and the two years following the commencement of solo driving. This tallying does indeed reduce the observed AD17 effectiveness in the first two years, though only by two percentage points. This applies both for VZR-recorded at-fault accidents and for recorded traffic offences excluding accidents.

The reduced accident rate of AD17 drivers, although demonstrated beyond reasonable doubt, is not clearly reflected in the age-related tables of official accident statistics. In absolute figures, it can be calculated that around 1,700 accidents with injury to persons were prevented by implementation of the model in 2009.

Conclusions drawn from the evaluation

1. Increased demand: Official statistics on the numbers of driving licences issued reflect developments in the demand for licences. The demand for driving licences for vehicle class B/BE across the whole population of persons under 19 years of age increased by around five per cent over the three-year phase of introduction of the AD17 model from 2005 to 2007. It seems reasonable to attribute this change to the availability of the AD17 model, even though final proof of causality is lacking. There are indications, however, that the increase in demand was only a temporary effect.

2. Survey results: A survey study which asked a random sample of over 18,000 young drivers – comprising AD17 participants and conventionally trained drivers from 11 federal states – to report on an initial period of solo driving lasting almost 14 months revealed period-based reductions of 19 per cent in accident involvement and 18 per cent in traffic offences. For an assessment of driving competence, a kilometre-based comparison is preferred: When measured per million kilometres driven, the reductions were even higher by a further four percentage points, namely 23 per cent in the case of accident involvement and 22 per cent for traffic offences. All results are statistically significant.

   A small proportion of this reduction, however, is attributable merely to an internal differentiation into high and low risks between the groups of AD17 drivers and those obtaining their driving

licence in the conventional manner. This differentiation does not lead to a reduction in accidents, but simply divides them differently between the two groups. After adjustment for internal differentiation relating to gender and vehicle availability, the reductions were 17 and 15 per cent instead of 19 and 18 per cent in the period-based comparisons; in the kilometre-based comparison, the corresponding figures were 22 and 20 per cent instead of 23 and 22 per cent.

A number of indicators support the causality of the effects of accompanied driving on the young drivers, above all the increased effectiveness with greater driving practice during the accompanied phase, the specific effect with regard to serious incidents and the fading effect over time. It is also proven that the positive effect of the AD17 model cannot be explained with a mere shifting of accidents and traffic offences from the phase of solo driving into the accompanied driving phase.

3. Replication: It is possible to replicate almost all obtained results for an independent sample of over 75,000 drivers and an extended observation period of on average 20 instead of 14 months. The significant reduction of 19 per cent in the rate of accidents per year is confirmed, as is the significant reduction of 18 per cent in the rate of traffic offences in the case of male drivers. It is not possible, however, to demonstrate a noticeable reduction in the rate of traffic offences attributable to the AD17 model in the case of female drivers – though this rate was already very low and thus not problematic.

4. Generalisability: The replication study also confirms that the results obtained with volunteer participants aware of the purpose of the study can be generalised in respect of a random sample of uninitiated persons. Likewise, the observed effectiveness remains practically unchanged when measured by way of at-fault accidents (in the replication study) compared to mere accident involvement as in the survey study. An analysis of a partial sample with an observation period of 24 months, furthermore, indicates the sustainability of AD17 effects, but at the same time also the limitations of the AD17 model: The positive effects of AD17 participation last well into the second year of solo driving, but then gradually fade and finally disappear almost completely.

5. Effect on accident figures in Germany: The reduction in accidents attributable to the AD17 model can be calculated at around 1,700 injury accidents in 2009. This corresponds to approx. nine per cent of the injury accidents caused by 18 to 19-year-old drivers.

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