

Construct Validity of Victoria's new licence test

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Abstract

A new drive test for car driver licence applicants has been developed in Victoria. The aim was to create a test that discriminates those young drivers who have completed the new mandatory minimum of 120 hours of supervised driving practice from those who have not. To ensure the construct validity of the new test, evidence-based conceptual frameworks were reviewed to identify the key constructs requiring assessment. Potential test items for each of these constructs were then drawn from a range of existing drive tests; where required new items were formulated, including a secondary task intended to assess drivers' 'spare' attentional capacity. This paper describes the conceptual basis of the new licence test, giving examples of test items for each of the key constructs. It also presents some on-road trial results concerning relationships between performance on the secondary task and indices of driver experience, measures related to safe-driving skills, and some test-specific variables. It was concluded that secondary task performance would not have practical value as part of a licence test. Some implications of the results for further research on driving skill development are discussed.

Keywords

Driver, licence test, attention, skill, inexperience

Introduction

In developing an on-road test of driving competence, one of the centrally important questions is: which elements of driving performance should the test evaluate? The answer to this question depends on the test's primary objective. In the context of Victoria's graduated licensing system, it was agreed that the objective in developing a new drive test should be to discriminate novices who have completed the new mandatory minimum of 120 hours of supervised driving practice from those who have not. This decision was based on the assumptions that amount of prior practice provides a good index of the extent to which driving skill has developed, and that novices with more highly developed skill generally drive more safely than those with lower skill levels. In fact, previous research suggests that novice drivers with almost 120 hours of experience as learner drivers have a lower risk of crash involvement than those with substantially less practice [1].

Therefore, one of the first steps in developing Victoria's new test was to specify a coherent conceptual framework that identified the aspects of driving performance of greatest relevance to skill development and their roles in driving task performance. This framework was then 'fleshed out' by identifying potential drive test items (i.e. specific aspects of driving performance that are amenable to assessment) for each construct.

This paper describes the conceptual framework that was used to identify the aspects of driving performance that are most relevant to driving skill development, along with examples of the kinds of test items that might be of use in assessing these aspects of performance. One of the key variables identified was the driver's attentional resources – both the total amount available for allocation to the driving task, and how it is allocated. A secondary task intended to assess drivers' attentional resources was trialled for potential inclusion in the test. In the second part of the paper, results from this trial are reported and their implications discussed in relation to different conceptual models of the driving task.

Conceptual frameworks for assessing level of driving skill development

In the case of very complex and variable activities such as driving, the most appropriate constructs to assess may not be obvious, and there are various ways in which 'driving skill' can be conceptualised, and some researchers have noted the absence of a practical taxonomy of normative driver behaviour [2, 3]. For the present purpose, driving was conceived as an activity entailing information gathering, processing and motor responses as depicted by the information processing model of Wickens and colleagues [e.g. 4] as adapted by Macdonald [5], shown in Figure 1. It can be seen that drivers' intake and perception of information from the environment, their cognitive processing of this information and their resultant actions all require some allocation of attentional resources. Cognitive processes are particularly demanding of attention, as indicated by the larger size of the vertical arrow near the top of Figure 1. Perception, Cognition and Actions are influenced also by drivers' relevant knowledge, expectancies and skill levels – that is, by their pre-existing driving competencies. In addition, their values and attitudinal characteristics relevant to driving influence perceptual and cognitive processes can influence both their perceptual and cognitive processes.

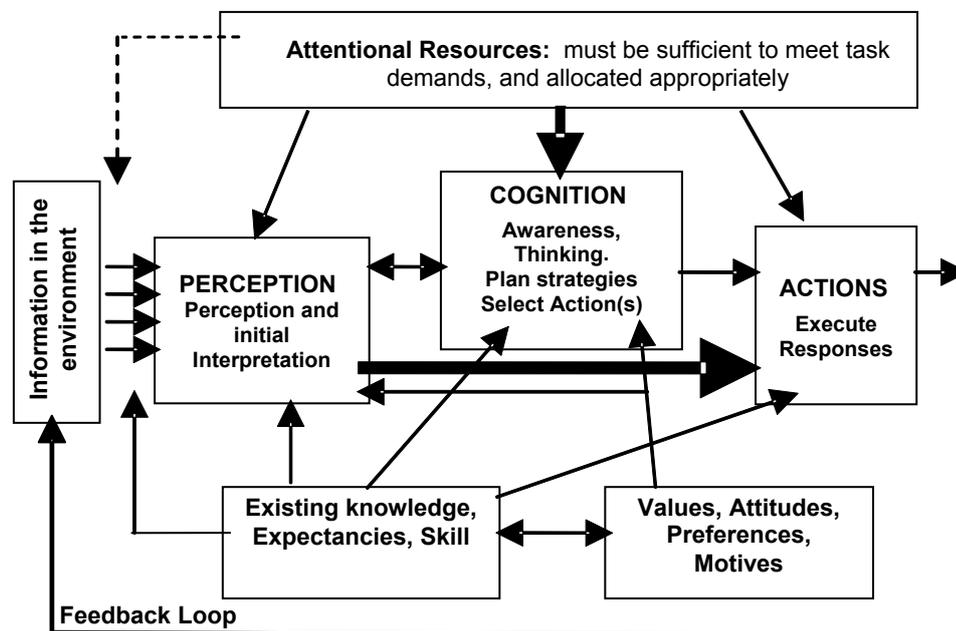


Figure 1: A generic depiction of how people 'process' information during activities such as driving (amended from Macdonald [5])

The large horizontal arrow in Figure 1, connecting Perception directly to Actions, indicates that sometimes information perceived by drivers can bypass the cognition stage and directly trigger the execution of responses – that is, the driver can respond to information with little or no awareness of it. As driving skill develops, an increasing proportion of incoming information is processed this way, with a corresponding decrease in the demand for attentional resources. This aspect of skill development is depicted more specifically by the 'Skills-Rules-Knowledge' (SRK) model of Rasmussen and colleagues, shown in Figure 2.

The SRK model has much in common with the earlier accounts of skill development by Fitts and Posner [6] and Welford [7]. All agree that more highly skilled people are likely to have a greater amount of 'spare' attentional capacity available during task performance, due to automatization of consistently 'mapped' task elements.¹ The SRK model conceptualises behaviour at three levels: knowledge-based, rule-based and skill-based. Initially, novice performance is controlled largely or entirely at a knowledge-based level. As 'rules' (consistent associations) are learned and as some components of performance become completely automatized, so that they require little or no attention, control spreads progressively

¹ 'Consistent mapping' means that a given stimulus always requires the same response.

down through the lower levels until, for an expert, performance is controlled to the maximum extent possible at the lower levels. The maximum achievable degree of automatisation is determined by the extent to which specific stimuli and responses are consistently mapped to each other. A driving-related example of consistent mapping is the relationship between amount of steering wheel movement (determined by the driver's control action) and the corresponding amount of movement of the vehicle (perceived via the feedback loop in Figure 1). Other examples might include manual gear changing, although this example is somewhat controversial [8, 9], and patterns of visual scanning of different types of environment [10].

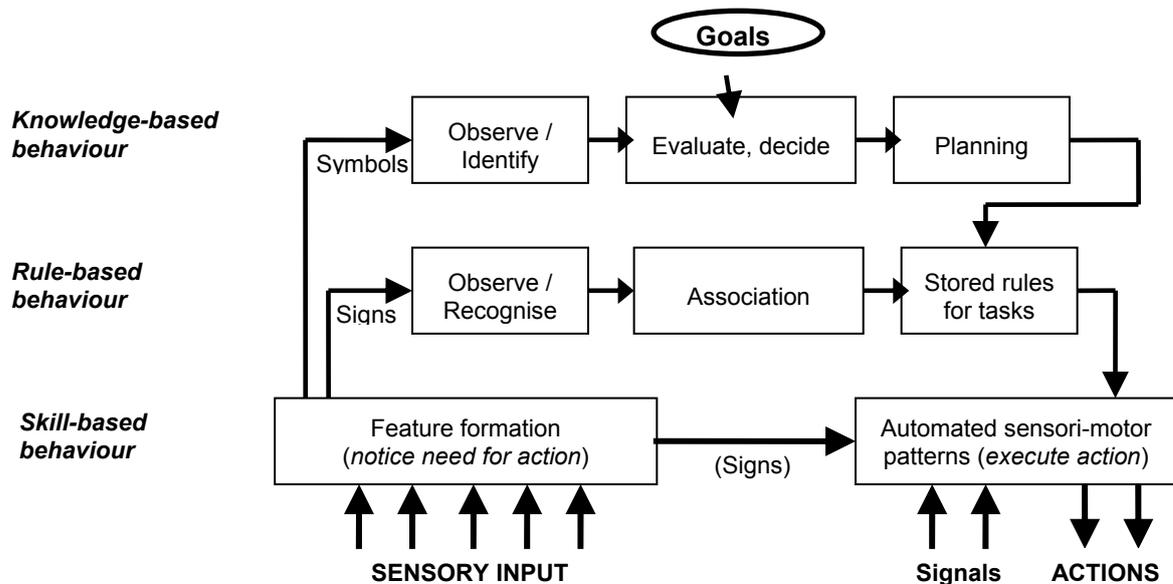


Figure 2: The basic Skills-Rules-Knowledge (SRK) model as developed by Rasmussen and colleagues, from Jensen and Koch [11].

Small elements of driving skill such as the above are gradually automatised to the maximum extent possible, and during this process are integrated within larger elements. For example, the entire process of driving the vehicle around a bend in the road probably entails a combination of *perceptual and motor* driving skill elements entailing perception of road and vehicle variables, plus *cognitive* elements concerned with the actual or potential presence of other vehicles. This process demands a decreasing level of attention as skill develops. Mayhew and Simpson argue that novice drivers are:

“... more likely than older experienced drivers to place themselves in dangerous situations because of an inability to integrate motor skills efficiently. Their operation of the vehicle is easily disrupted when the demands of driving increase beyond the norm. In such situations, they encounter difficulties in dividing their attention across several tasks. Their greater inability to steer properly and maintain constant speed when task demands are high makes it more difficult for them to maintain the vehicle in the lane and negotiate curves properly.” [12, p.3]

However, the behaviour entailed in driving a vehicle on public roads can never be *completely* automatised, because of its inherent uncertainties. Some attention is always required due to the actual or at least potential presence of other traffic, along with the potential for other variations from what is expected, perhaps including variability of the driver's own actions even when these are largely or entirely automatised [9].

In the above quotation, Mayhew and Simpson appear to attribute novice drivers' performance deficiencies primarily to inadequate attentional resources and consequent attentional *overload*. However, there is also the issue of how available resources are *allocated*; inadequate attention allocation to a particular tasks or sub-task can arise for reasons other than overload. For example, inadequate development of hazard perception skills might mean that the *need* for more attention to a particular task

component is not perceived. Or as depicted in Figure 1, the drivers' 'values, attitudes, preferences, motives' might cause them to place a higher value on some sub-tasks or activities than others; for example, they might allocate considerable attention to conversation with passengers, because of its perceived significance or personal importance, with sub-optimal attention to some aspects of their driving, such as carefully scanning and monitoring changes in the road traffic environment. The accuracy of a young driver's level of 'calibration' – of self-perceived driving competence in relation to driving task demands – is also expected to influence the way in which attention is allocated [13, 14]. The attention allocation aspect of performance is variously referred to as a function of executive function or control, or supervisory control [see 15].

Fuller [16], in describing his general theory of driver behaviour, uses the category 'human factors' to encompass factors other than skill development and other determinants of overall competence. According to this model, such factors are related to "attitude, motivation, effort, fatigue, drowsiness, time-of-day, drugs, distraction, emotion and stress" (p.464). Fuller specifically notes that "Part of the motivational variable contributing to the determination of driver capability is resource allocation—the extent to which the driver is motivated to allocate the resources needed to carry out the task so that capability is maintained well above task demand." (p.464) On this basis, he conceptualizes both driving 'competence' and the driver's motivational variables within a broader construct termed 'capability' (at any given point in time), as shown in Figure 3.

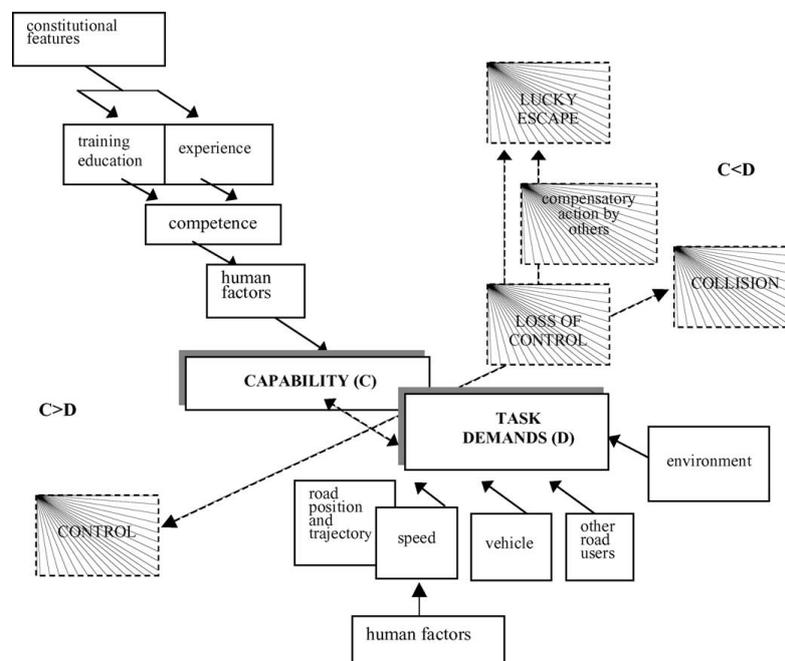


Figure 3: Fuller's general model of driving behaviour, which he terms the 'task-capability interface model' [16].

Key constructs underlying novice driver performance

Based on the conceptual frameworks outlined above, the following constructs were identified as important for inclusion in the assessment of novice drivers' level of skill development.

Intake and Perception of Relevant Information. These processes are influenced by perceptual/cognitive skill development, including the completeness and accuracy of mental models and associated expectancies. During a drive test it is difficult to observe more than the most rudimentary signs of such performance elements, despite their contribution to all driving manoeuvres.

Relevant test items include mirror checks and headchecks. In the case of perception itself, this is probably best assessed by a hazard perception test that has been validated as effective in discriminating drivers with 120 hours practice from those with substantially less practice.

Perceptual and Cognitive Processes. The process of perception overlaps information intake on the one hand, and cognition on the other. For this reason, it is often impracticable to distinguish clearly between the two – particularly when high levels of driving skill development allow some kinds of decision making to be ‘recognition-primed’, meaning that familiar situations are perceived and responded to with little or no attention. However, even with high levels of skill, tasks such as gap selection – when negotiating intersections, changing lanes, overtaking, and so on – demand considerable attention.

Assessing perceptual and cognitive aspects of driving performance is difficult, since they are not directly observable and assessments must be based on resultant, observable actions. However, these processes play a key role in the performance of all driving manoeuvres. For example, during performance of a low-speed manoeuvre, which is typically seen as primarily demanding vehicle control skills, the driver might need first to detect and select an appropriate location and related turning strategy, and to select an appropriate gap in traffic if re-entering the stream. Throughout the manoeuvre the driver has to continually monitor available information concerning the potential presence/actions of other road users, and needs sufficient attention capacity to co-ordinate all performance elements and the skill to divide attention between them, flexibly re-allocating attention as needed at different stages of the manoeuvre.

Periods of commentary driving might be one way of *directly* assessing the driver's perceptual and cognitive processes, but the process of generating a commentary is in itself highly demanding of attentional resources, to a degree that would be likely to interfere with driving performance – particularly for novice drivers who are likely to have inadequate ‘spare’ attentional resources to maintain error-free performance of other aspects of the driving task concurrently with generating a commentary, which would create major assessment difficulties. A more practicable option might be presentation of occasional ‘probe’ questions to assess situation awareness related to the immediately past road traffic situation. These would need to be presented at locations where the route changed from a complex/demanding section to a much less demanding segment, and might entail the driver first pulling over to the kerb and parking, prior to responding to the question. This option was considered for adoption, but ultimately discarded because of the questionable equity of requiring verbalisation – in English – of what might sometimes be quite complex perceptual/cognitive processes. It was decided that such an approach would unfairly penalise people with poor verbal fluency, as well as those with poor English language skills. As in the case of assessing hazard perception skill, the most satisfactory assessment method might be an off-road test, which would need to be developed for this purpose.

Vehicle Control Performance. These aspects of driver behaviour are typically seen as central to driving skill development, and have been the main focus of driver testing in the past. They have the great advantage of being directly observable, and can be assessed by items such as lateral position within the lane, following distance, speed, and safety margins during manoeuvres such as lane changing and intersection negotiation in the presence of other road users. Such items were all included in the test.

Based on evidence that skilled performance is characterised by its timeliness, smoothness and overall good co-ordination, a rating scale to enable licence testing officers to assess this more general aspect of driving skill level was also trialled.

Automatisation of consistently mapped stimulus-response performance components. While this aspect of driving skill cannot be directly assessed, it is possible to assess amount of ‘spare’ attentional resource, which is conceptualised as providing an index of automatisation that tends to increase with increasing skill. There is a large research literature on potential measurement methods (see [17] for a review), of which use of some kind of secondary task was judged to be the most appropriate for the present purpose. None of the previously documented secondary tasks appeared practicable for use as part of normal licence testing, so a more suitable alternative was created for trialling, as described in the following section.

Some consideration was also given to the possibility of assessing *executive control* of attentional resource allocation. One assessment option considered would entail the licence testing officer attempting to engage the driver in conversation at several points along the route, including some where the driver could

reasonably be expected to have sufficient spare attention to respond (and would be expected to do so), and some others where it would be more appropriate for the driver to defer any response until later, because of the high level of driving task demands at that time. However, this option was discarded on the grounds that it would be very difficult to implement reliably, and could well be seen as unfair since it would sometimes require drivers to ignore the licence testing officer, which some candidates might feel to be inappropriate or even rude.

It was recognised that drivers' ability to allocate attention allocation appropriately might undermine the validity of secondary task performance as a measure of spare attention resources. This depends on compliance with the instruction to give complete priority to the primary task of driving (which is a core requirement of the 'secondary task' method). The driver might *choose* not to comply, or might simply be *unable* to assess just how much attention is required in order to comply with such an instruction. Compliance might be particularly difficult for young drivers' whose 'calibration' tends to be poorer than that of more experienced drivers [see 14]. Nevertheless, it was decided to trial a secondary task performance measure, as described in the following section.

Method²

Participants. Learner drivers were recruited with the aim of achieving a total sample size of at least 400, stratified to have approximately equal numbers of males and females. According to self-reports, they all had at least 50 hours and some had over 120 hours of prior driving experience, evenly distributed over this range; they were aged 16 to 19 years, inclusive. A small financial payment was offered, as an incentive to encourage attendance at the pre-arranged time.

Assessment procedure. Assessment was undertaken in a dual-control vehicle owned by a professional driving instructor. The instructors were recruited for the study and paid for their involvement. The instructor sat in the front passenger seat during the assessment drive, with the licence testing officer seated in the left, rear seat. Completion of the assessment drive took about 45 minutes.

Test route locations. Routes for this (second) phase of the project were developed in the vicinity of VicRoads customer services centres located in three very different kinds of location: Carlton, close to Melbourne's CBD; Frankston, an outer suburb; and Morwell, a small regional centre. Routes were designed to include as many as possible of the driving tasks/manoeuvres and assessment items that had been selected for trialling, but there were some unavoidable differences between routes due to their varying locations. About 25 percent of participants were assessed at Morwell and the rest were evenly divided between Carlton and Frankston.

Each of the three routes included two sections during which drivers were asked to perform a secondary task: one straight section of road in a 60-70 km/h zone, and one straight section of freeway.

The secondary task. This was designed to be practicable for use as part of normal licence testing; it was generally termed 'the numbers task'. Drivers were required to listen to a pre-recorded series of single digits from 1 to 9, presented in pseudo-random sequences (modified to exclude *apparent* deviations from randomness) at a rate of one per 1.5 second. On average, a total of 39 digits were presented per section. The task was to say 'yes' each time any of three target numbers (4, 5, 6) was heard. Instructions emphasised that:

... good drivers have to concentrate on lots of things – the road, other traffic, and so on, and sometimes they might *also* want to talk to a passenger. Often this is fine ... but sometimes they have to concentrate fully on driving and not talk to their passengers. *A good driver always concentrates on driving safely, even if sometimes they don't hear everything the passenger says.* ... If driving needs your full concentration and you miss a number – don't worry ... Try to get as many numbers as possible, but most importantly ... *keep driving safely.*

² For a more comprehensive account of test development phases and trial methods, see the paper by Catchpole and colleagues, these proceedings.

Secondary task responses were digitally recorded by the licence testing officer, who subsequently transferred performance details to a standard score sheet.

Calculation of secondary task scores

Recorded performance details were: number of digits presented; number of correct responses to targets (hits); number of failures to respond to targets (misses); number of incorrect responses to non-targets (wrong responses). These variables were used to create a score for each participant on each of the two sections. Several possible ways of calculating scores were investigated, none of which produced markedly different results from the others. The formula selected for use was: $\text{hits} / (\text{total digits presented} + \text{misses} + \text{wrong responses})$. This formula produced scores that were more strongly correlated with measures of drivers' reported amount of driving experience, compared with those using other possible formulae. High scores reflected better performance in identification and responding to target digits.

Results

Results reported here are for secondary task performance analysed in relation to a range of other variables.

Secondary task performance was found to be significantly better on freeway sections of the test routes (mean = 0.37, SD = 0.053) than on the lower speed sections (mean = 0.31, SD = 0.046; $t_{(409)} = 24.5, p < .05$). Distributions of these scores are shown in Figure 4.

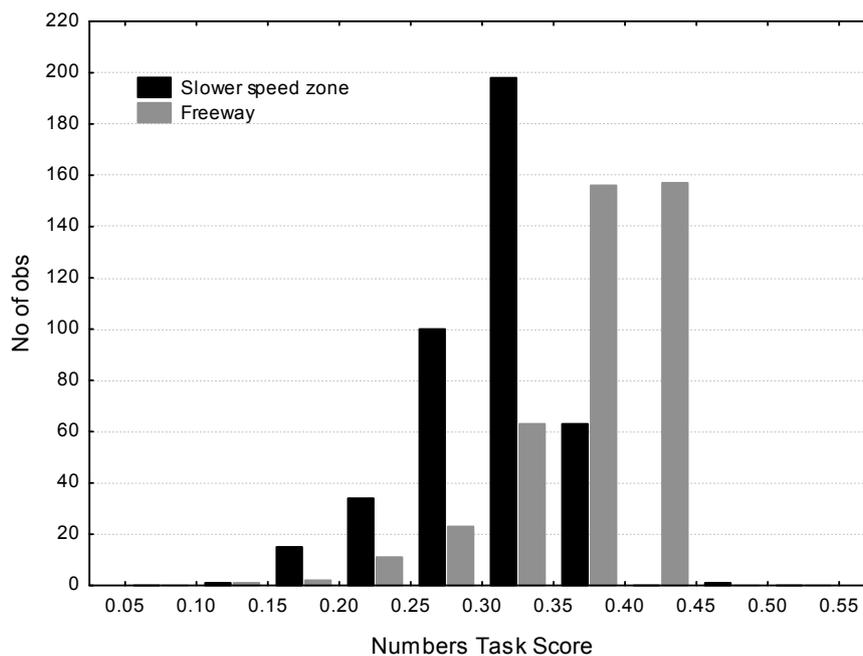


Figure 4: Secondary (numbers) task score distributions, separately for freeway and lower speed sections of test routes.

Effects of gender, the transmission type of the car used in the trial, and the trial location (Carlton, Frankston, or Morwell) on secondary task performance score were analysed using a three-way ANOVA. There was no significant effect of gender. For both freeway and lower speed sections, the effect of location was statistically significant, as shown in Figure 5a. Looking only at scores on lower speed sections, the interaction between location and transmission type was significant, as shown in Figure 5b.

Post hoc testing of pairwise comparisons (using the Scheffe correction) indicated that performance was better on the freeway section in Carlton than on the freeway sections at Morwell and Frankston. In lower speed zones, performance was worst at Morwell (significantly so, compared with Carlton); this was primarily due to the poor performance of drivers of *manual* cars at Morwell, who performed significantly worse than other participants.

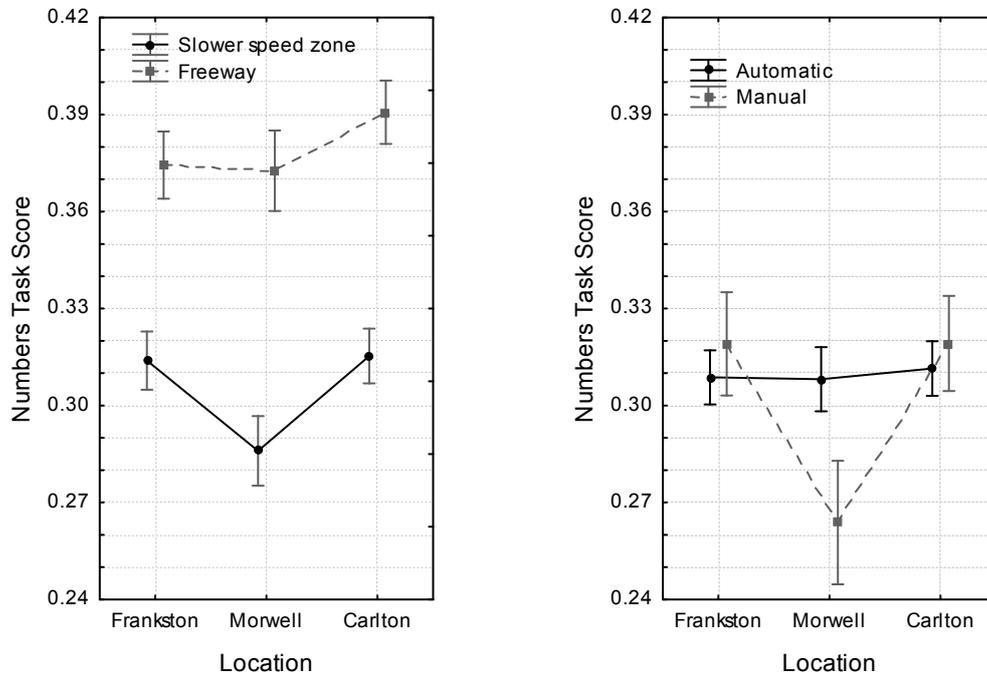


Figure 5: Performance on the numbers tasks disaggregated by location (Figure 5a, on the left), and by location and transmission type for lower speed zones only (Figure 5b, on the right)

Relationships between secondary task performance and other variables were investigated using two general regression analyses for freeway and lower speed sections separately. The focus of the analysis was the extent to which learner experience, safe driving skills, and task-specific variables predicted performance on the secondary tasks. Secondary task performance was used as the criterion variable and the following variables were used as potential predictors.

- Measures of learner driver experience:
 - Total self-reported on-road experience
 - Self-reported experience in wet weather conditions
 - Self-reported experience driving in high speed zones
- Measures related to safe-driving skills:
 - Performance on new drive test items recommended for the final test trial that were selected based on their correlation with safety-related measures
 - Performance on the Victorian Hazard Perception Test
- Categorical measures relating to the conditions under which the test trial took place:
 - Assessment location (Morwell, Frankston, Carlton)
 - Vehicle transmission type (manual, automatic).

The general regression model allowed for the inclusion of interaction terms. The variables used in the analyses therefore included the interactions between the two categorical variables (given the interaction between location and transmission type noted earlier) and between vehicle transmission type and the experience- and safe-driving related measures. This attempted to identify any difference in cognitive workload between driving cars with manual and automatic transmission.

The regression analyses used stepwise entry of predictors. Results are summarised in Table 1, where it can be seen that although both models reached statistical significance, the adjusted R^2 values were very low.

Table 1: Standardised regression coefficients for predictors included in the stepwise regression analyses

	Beta	Std.Err.	t ₍₃₇₁₎	p-level
LOWER SPEED SECTIONS				
R = .29 R ² = .086 Adjusted R ² = .071 F _(4,371) = 5.8, p < .05				
Location (1)	0.17	0.07	2.25	.024
Location (2)	-0.38	0.07	-4.94	.000
Hours driving in wet conditions	-0.14	0.05	-2.66	.008
Vehicle type by Hours driving on high speed roads	0.14	0.05	2.66	.008
Vehicle type by location (1)	-0.16	0.07	-2.11	.035
Vehicle type by location (2)	0.29	0.07	3.84	.000
FREEWAY SECTIONS				
R = .24 R ² = .060 Adjusted R ² = .044 F _(3,371) = 3.9, p < .05				
Hours driving in wet conditions	-0.17	0.05	-3.07	0.002

Secondary task performance on the freeway section was predicted only by the reported amount of prior driving experience in wet weather conditions. Participants with more wet weather driving experience performed less well in the secondary numbers task. Experience in challenging driving conditions was considered to reflect a higher level of safe driving skill during the test development project, so this result is consistent with the notion that drivers with better safety-related driving skills tended to allocate attention to the driving task at the expense of the secondary task.

Secondary task performance in the lower speed driving task was predicted by location, the interaction between location and vehicle type, the amount of driving reported in wet weather conditions, and the interaction between vehicle transmission type and the amount of driving reported on higher speed roads. The relationship between secondary task performance and location and vehicle type was described above in relation to Figure 5. The relationship between secondary task performance and wet weather driving experience was in the same direction as that noted above for the secondary task on a freeway section – again consistent with the notion that drivers with better safety-related driving skills tended to allocate attention to the driving task at the expense of the secondary task.

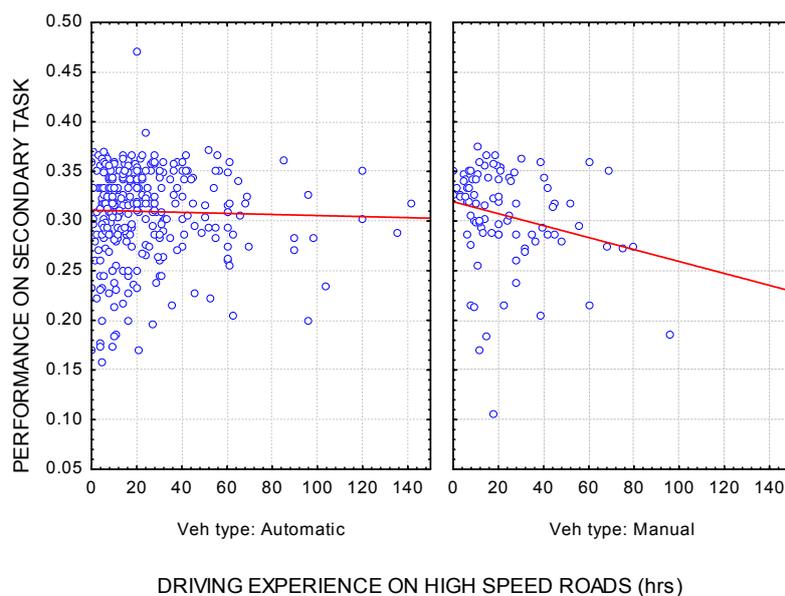


Figure 6: Performance on the secondary task while driving in a slower speed zone and driving experience on high speed roads – for drivers in automatic and manual cars

The relationship between secondary task performance and the interaction between vehicle transmission type and experience on high speed roads is shown in Figure 6, where an inverse relationship between secondary task performance and reported experience on high speed roads (as was the case for experience in wet weather conditions) can be seen, but only for drivers of manual cars.

Discussion

Inclusion of a secondary task in the test development trial provided an opportunity to assess drivers' ability and/or willingness to allocate attention to this task as well as to driving.

In terms of Figure 1, it provided an index of how much attentional resource drivers had 'left over' for the secondary task, after all the resources needed for the primary task had been 'taken' as required. On this basis, and consistent with the SRK model shown in Figure 2, better performance on the secondary task would be expected to indicate a greater overall amount of 'spare' attention. Amount of 'spare' attention might be greater due to either to a lower level of task demands, or to a greater degree of automatization of driving skills because of a higher level of skill development.

Consistent with this notion that performance on a secondary task can be a measure of 'spare capacity', it was found that secondary task performance was superior when driving on a freeway road section than in a slower speed zone. If it is assumed that driving on a freeway is less cognitively demanding for the driver, due to the greater predictability of other road user actions, then better performance on a measure of spare capacity can be expected. (This finding is also consistent with evidence that freeway driving is relatively *safer* than driving in more unpredictable road environments, even with lower speeds on the latter.)

Also, it was found that in lower speed zones (viewed as more demanding based on the above argument), secondary task performance at one location (Morwell) was worse than at the others, primarily due to the poor performance of drivers of *manual* cars there. It is well established that driving a manual car is more demanding of attentional resources than driving an automatic transmission car (e.g. Shinar et al, 1998), so again, this result is in accord with the above interpretation. Why this finding was confined to just one of the three locations is unclear. One possible explanation is that there was an unintended higher level of driving task difficulty of those lower speed road sections at that location – particularly for drivers of manual-transmission vehicles.

However, a different picture begins to emerge when reviewing results from the regression analyses, where secondary task performance was used as a criterion measure and a range of experience, 'skill', and contextual variables were used as predictors. Although the regression models for both secondary task contexts were statistically significant, the proportion of variance accounted for in each case was very low and none of the potential predictors had a strong relationship with performance on the secondary task. Further, drivers with more prior experience of wet weather driving – which in the context of the test development project was considered to reflect a higher level of driving skill – performed *less* well on the secondary task.

Based on the view that more experienced drivers have a higher level of 'spare' attentional resources and should therefore be able to perform better on the secondary task, the above results were surprising. The analyses failed to show any relationship between *total* learner driver experience and secondary task performance, and the magnitude of the expected relationships between secondary task performance and the two 'challenging driving' experience measures (driving in wet weather, and on high speed roads) were very small, and in opposite directions. Similarly, it was surprising that neither of the 'skill' measures (performance on the test items and performance on the HPT) were included in the regression models as predictors of secondary task performance.

For a possible explanation it is necessary to change focus from the *amount* of attentional resource available to drivers, looking instead at the way in which these resources are *allocated* between tasks and sub-tasks. This allocation process would be expected to be influenced by drivers' level of calibration, as well as by what Fuller terms 'human factors' as shown in Figure 3. Young, inexperienced drivers tend to be less well calibrated than more experienced drivers, meaning that they misperceive the relationship between their own performance abilities and the demands of the driving task. Misperception of this relationship – regardless of whether it is due to drivers' poor hazard or risk assessment skills and/or over-

confidence in their own driving ability – could well result in allocation of an inappropriately large amount of available attention to a secondary task. From this different viewpoint it is understandable that more skilled drivers (those with more prior experience of wet weather driving) evidently were likely to allocate a greater proportion of their attention to the driving task at the expense of the secondary task.

In light of the above discussion, the very small relationships between driving skill indicators and secondary task performance are less surprising, since the effects on secondary task performance of drivers' overall *amount* of available attentional resources, versus the effects of drivers attention *allocation* performance, would tend to neutralise each other.

It should also be noted that substantial differences in level of driving skill – to an extent that would have a major impact on either amount of available attention or calibration – could not be expected, since the total period over which driving skill develops is very much longer than the range included here, where the 'experienced' and 'inexperienced' groups actually differed very little. Participants in the trial had an average of 90 hours of driving experience, whereas Brown [18] suggested that the development of what he terms 'road craft' takes years of driving experience, and novice driver crash risk declines over a number of years of driving experience. Benda and Hoyos [19] classified drivers with less than 75,000km of driving experience as 'inexperienced'. In a study of particular relevance to the present one, Shinar *et al.* [10] obtained evidence demonstrating the very long taken for manual gear-changing skills to develop, based on the performance of 'novices' (a mean 1.5 years of driving experience) driving manual versus automatic transmission vehicles, compared with two comparable groups of 'experienced' drivers (a mean of 8 years of experience). In this light, it is not surprising that effect sizes for experience-related variables in the present study were small or non-existent.

The complex set of factors found to influence secondary task performance in this trial made clear that it would not be of practical value as part of a licence test. From a research perspective, however, the results suggest that it would be useful to conduct further research to investigate differences between young drivers with a much large range of experience levels, specifically measuring 'spare' attentional resources and attention allocation strategies in different driving situations, as well as driver calibration levels. This might provide very useful insights into the processes underpinning the slow development of safe driving skills and the gradual decline in crash risk as drivers continue to gain experience into their 20s. Finally, these results also suggest a need for models of driving behaviour to more explicitly represent the separate effects on performance of the above variables. Fuller's model [16] separates "competence" (which is a product of experience) from "human factors", with the latter including "motivation" and "distraction", among a wide range of other factors. Importantly, he notes that the "motivational variable" should be interpreted as influencing the way in which attentional resources are allocated by the driver. Further explication of the nature of 'calibration' in this context would be helpful.

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