Chapter 21

Predicting Driver Behaviour

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Background

Psychological assessment of individuals who have been disqualified from driving and who now wish to renew their licences and those seeking employment as, for example, bus drivers has become a major industry in some countries. Yet the task of assessing and predicting driver behaviour and accident proneness has proved to be no easy matter and, as is shown in this chapter, yields some surprising results. The results reported here are fairly typical of those emerging from a number of validation studies conducted in different countries.

Population studied

The total group from which those involved in the present study were chosen consisted of 786 applicants for positions as bus drivers. Following training, they were assessed by their instructors and recommended, or otherwise, for employment.

In order to eliminate the effects of variation between instructors, the present study focused on 229 drivers who had been assessed by a single instructor. 125 of these were recommended for employment and 103 not recommended.

In addition, a study was made of the driver errors recorded by the instructors and efforts made to predict both instructor recommendation and driver errors from batteries of psychological tests.

Assessment of driver competence

The aspects of driver behaviour assessed by the instructor are given in Table 21.1.

Table 21.1. Components of Driver Behaviour Assessed by Instructor

Vehicle Check outside	Observation/blindspots
Vehicle Check inside	Positioning
Reversing	Turning
Steering	Spacing between vehicles
Clutch	Overtaking
Brakes	Intersection
Acceleration	Driving: downhill
Gears	Driving: uphill
Indicators	Attitude eg aggressive
Horn	Courtesy
Mirrors	Ability to talk and drive at same time.

Because there was too little variance on each of the variables (turning, use of horn, etc.) taken singly, an overall index of the total number of errors made by each driver was computed.

Psychological assessment

The tests were administered by computer using the Vienna Test System developed by G. Schuhfried, GmbH, Austria. The tests selected had been validated in previous studies conducted by that company.

The test battery consisted of:

- COG - Cognitrone (Concentration test), Testform: S9
- DT - Determination Test (Stress test), Testform: S5
- RT - Reaction Test, Testform: S3
- LVT - Visual Pursuit Test (Perception test) , Testform: S2
- ZBA - Time-Movement Anticipation, Testform: S3
- 16PF - 16-Personality Factor-Test (Cattell)
- SPM - Raven's Standard Progressive Matrices

Results

Predicting whether a Driver will be recommended or not.

The psychological test variables on which the drivers who were recommended for employment differed significantly from those not recommended are shown in Table 21.2.

From the results relating to the Concentration test (Cog), it would seem that recommended bus drivers show significantly more correct reactions and their reaction times are shorter, regardless of whether their reactions are correct or incorrect.

The time-movement anticipation (ZBA) test scores of the recommended drivers are also better; they can better anticipate where e.g. a car will be on the street some moments later.

On the Stress Test (DT), recommended bus drivers make significantly more correct reactions, and less incorrect, delayed and omitted reactions, and are generally faster.

The SPM scores of the recommended drivers are significantly higher than those who are rejected.

And, on the 16PF, the recommended bus drivers are significant more sociable, obtain higher abstract thinking scores, have a greater sense of duty, and generally think more carefully about things.

Predicting driver errors

As previously mentioned, the analysis was carried out using a single overall index of number of errors.

To simplify the analysis, the test scores from the psychological tests were first factor analysed. These analyses were run separately for the ability and personality tests. Because the initial results yielded some counter-intuitive results for the reaction time tests, these were dropped from the analysis. The results of the revised analyses are shown in table 21.3 and 21.4.

From Table 21.3, it appears that only Factor 6, whose main loading is on the SPM, is significantly able to predict driver errors. None of the personality factors predict the total driver error score.

These results are typical of those found in many traffic validation studies conducted by the author and his colleagues, and they also replicate the results of many wider test validation studies conducted since the Second World War and summarised in other chapters of this book. Time and again it emerges that, when some measure of general cognitive ability (of which the *Raven's Progressive Matrices* is the most cost-effective) is included in a battery, it mops up virtually all the predictive validity of the other tests. The results reported here strongly reinforce the conclusions

Table 21.2. Significant Differences Between Recommended and Not Recommended Drivers

Variable name	*Mean value: Recommended drivers*	*Mean value: Not recommended drivers*	*Significance*
Cog Sum "correct reactions"	437.72	372.43	p = .000
Cog Mean time "correct reactions" (sec)	.87	1.02	p =.001
Cog Mean time "incorrect reactions" (sec)	.84	1.02	p = .016
Zba Median direction deviation (total)	26.86	33.23	p = .028
Dt Median reaction time	.83	.92	p = .000
Dt On time	335.50	233.74	p = .000
Dt Delayed	127.93	166.44	p = .000
Dt Incorrect	62.55	103.71	p = .041
Dt Omitted	55.46	105.06	p = .000
SPM Raw score	35.56	29.67	p = .000
16PF_A: Sociability	5.28	4.77	p = .010
16PF_B: Abstract thinking	5.32	4.76	p = .028
16PF_G: Sense of duty	6.32	5.48	p = .000
16PF_N: Thinking carefully	4.90	4.50	p = .031

Table 21.3. Factor Analysis: Ability Tests Without Reaction Test

Rotated Components

	Component					
	1	2	3	4	5	6
Age	.032	.574	.048	-.008	-.023	-.075
cog Sum “Reactions” (right and wrong Reactions)	.934	-.229	.071	-.118	-.099	.025
cog Sum “right Reactions”	.930	-.235	-.090	-.113	-.103	.007
cog Sum “wrong Reactions”	.103	.018	.971	-.041	.015	.109
cog percent range “wrong Reactions”	-.072	.040	.974	-.009	.004	.046
cog Mean time “right Reactions” (sec)	-.938	.210	-.032	.130	.051	-.005
cog Mean time “wrong Reactions” (sec)	-.821	.172	-.031	.136	-.151	-.014
lvt Median time right answers (sec)	-.168	-.003	-.090	.932	.045	-.005
lvt score	.220	-.012	-.044	-.929	-.095	-.019
zba Median Deviation time	.023	.146	.011	.049	.658	-.032
zba Median Median direction	-.028	.170	-.032	.075	.770	.024
dt Median Reaction time (Modus Reaction)	-.201	.950	.000	.015	.104	.027
dt on time (Modus Reaction)	.227	-.929	-.033	.007	-.162	-.066
dt delayed (Modus Reaction)	-.200	.894	.019	.049	.006	.036
dt Incorrect (Modus Reaction)	.068	-.178	.235	-.220	.017	.403
dt Omitted (Modus Reaction)	-.197	.749	-.009	-.023	.278	-.072
SPM raw score	.341	.127	-.216	-.087	-.396	-.576
driving errors total	.108	-.066	-.178	.219	-.345	.579

Extraction method: Main components Rotation method: Varimax with Kaiser-Normalization

a. The Rotation is converged in 7 Iterations.

Table 21.4. Factor Analysis of 16 PF Test

	Component				
	1	2	3	4	5
Warmth (Reserved vs. Warm; Factor A)	-,182	,054	-,091	,769	,093
Reasoning (Concrete vs. Abstract; Factor B)	-,033	,704	,292	,139	-,232
Emotional Stability (Reactive vs. Emotionally Stable; Factor C)	-,488	,401	-,356	,109	,106
Dominance (Deferential vs. Dominant; Factor E)	,058	-,495	,574	-,072	-,132
Liveliness (Serious vs. Lively; Factor F)	,043	-,001	,136	,757	-,082
Rule-Consciousness (Expedient vs. Rule-Conscious; Factor G)	-,254	,596	-,123	-,150	,143
Social Boldness (Shy vs. Socially Bold; Factor H)	-,738	-,038	,091	,077	-,004
Sensitivity (Utilitarian vs. Sensitive; Factor I)	-,102	-,025	,061	-,004	,421
Vigilance (Trusting vs. Vigilant; Factor L)	,345	-,105	,471	,027	-,410
Abstractedness (Grounded vs. Abstracted; Factor M)	,121	-,070	,628	,143	,011
Privateness (Forthright vs. Private; Factor N)	,225	,481	-,113	,102	-,138
Apprehension (Self-Assured vs. Apprehensive; Factor O)	,712	,035	,058	-,057	-,060
Openness to Change (Traditional vs. Open to Change; Factor Q1)	-,151	,212	,713	-,118	,224
Self-Reliance (Group-Oriented vs. Self-Reliant; Factor Q2)	,521	-,090	,097	-,361	-,139
Perfectionism (Tolerates Disorder vs. Perfectionistic; Factor Q3)	-,546	,071	-,135	-,085	-,285
Tension (Relaxed vs. Tense; Factor Q4)	,549	-,487	-,014	,097	-,117
Driving errors total	,128	-,041	-,022	,030	,682

that stem from Carroll's 1993 book *Human Cognitive Abilities: A Survey of Factor-Analytic Studies*: Attempts to "improve" the measurement of eductive and reproductive ability using "more basic" measures like "attention" and "reaction time", while greatly extending the time needed for testing (and improving the face validity of the battery), have added surprisingly little to either our scientific understanding or our professional competence.