CRITICAL REVIEW OF VISION FITNESS TESTING WITHIN THE SOUTH AFRICAN DRIVING LICENSE TESTING AND ROAD SAFETY CONTEXT[1]

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Abstract:
In the South African context visual fitness testing prior to issuing a learner's, driving license or authorizing the renewal of a driving license has been legislated since 1998. Of all the medical fitness disqualifiers, visual fitness has been prioritized as perhaps the most important medical condition to be verified through eye-testing procedure at a licensing authority. All other medical conditions are disclosed or declined through a concise declaration by the applicant. This study shows firstly, that the causal factors of certain vehicle accidents are not significantly related to visual fitness. Secondly, considering the substantiated low failure rate through eye-testing at driving license testing centres, the study suggests there is no justification for the current prescribed eye-testing procedure and accompanying operational and capital budget implications without the other relevant eye-testing procedures.

Key words: *Eye-testing, visual acuity, visual field, driving license, driver view field analysis, vehicle accident*

Introduction

The principle of keeping a proper lookout or failing to do so is well imbedded in law within the South African context [1, 2, 3, 4]. In many litigation cases the apportionment of negligence is decided, based on the principle of failure to keep a proper lookout by one or both or more drivers involved in a vehicle accident [1, 2, 3]. The latter legal principle will for many confirm the importance of vision fitness. However, the ability to keep a proper lookout is not a function of perfect vision versus some degree of vision impairment alone. It will be argued by the authors that a conscious awareness of the principle of keeping a proper lookout which is dependent on visual acuity and visual fields and other as reported in [5], and the skill to timeously foresee road usage risks and finally, competent driving skills in general are overwhelmingly more important factors to be considered in road safety strategies aimed at reducing the road carnage on South African roads.

Readers are reminded of a convincing finding reported in [6] that drivers with visual defects are no more vulnerable to have accidents than those with normal vision. The aforesaid finding is supported in a critical review of the existing literature related to vision, driving competency and accidents. The authors Owsley et al. present a critical review on reported findings found in 211 research papers [7].

In South Africa, compulsory eye-testing to verify visual fitness meeting minimum visual acuity and visual field requirements has been legislated since 1998 [8]. Eye-testing became standardized procedure during the period of converting driving licenses to the credit card format and for obtaining a learner's or driving license or renewal thereof, thereafter. Implementing the legislation with the considered view of government that such tests should be freely available to all citizens necessitated enormous financial investment in amongst others, retraining of examiners for driving licenses, provision of eye-testing equipment throughout the driving license testing centres (DLTC's) countrywide, specialized stationary and other auxiliary services. Cycling all driving license holders through the driving license card conversion process was a rather frustrating process for many citizens. The current driving license renewal process proves to be equally cumbersome and certainly time consuming. Admittedly, an analysis of process flow efficiency and the cost-benefit of eye-testing is not the theme of this research project but, anecdotal evidence suggests that very little value is added to accident reduction, driving skills and road usage behaviour. The latter suggestion motivated this study. The authors are convinced that the millions spent on this singular aspect of driver fitness as a holistic competency should be re-channeled appropriately. Arguably, other important road safety factors come into play. However, accepting that not all can be done simultaneously, the objective of this research is to convince the case that decisive leadership and implementation strategies must be sought to (i) define a more comprehensive (meaningful) eye-test protocol to be performed by professionals rather than the instrumental approach by semi-skilled officials at driving license testing centres; (ii) capacitate driving license testing centres to prevent corrupt and incompetent driver testing, effectively; (iii) operationalize concerted and effective speed law enforcement; (iv) development of a sense of foreseeability of risks amongst road users through amended training curriculum, prior to issuing driving licenses.

Mathematical Analysis of Two Types of Intersection Accidents

The visual fitness standards for obtaining or holding a learner's or driving license are prescribed in Regulation 102 of the National Road Traffic Act, (Act 93 of 1996), [8]. The standards provide for two clusters of driving licenses i.e. code A1, A, B or EB (motorbikes and light motor vehicles) and code C1, C, EC1 or EC (heavy motor vehicles). Regulation 102 of the Act prescribes as follow:

(i) Code A1, A, B or EB a Snellen rating of minimum visual acuity of 6/10 for each eye and; a minimum visual field of 70 degrees temporal for each eye, or where visual field of one eye is less than 70 degrees a minimum total horizontal visual field of at least 115 degrees. In all standards with or without refractive correction applies.

(ii) Code C1, C, EC1 or EC a Snellen rating of minimum visual acuity of 6/9 for each eye and; a minimum visual field of 70 degrees temporal for each eye. In all standards with or without refractive correction applies.

In the South African context approximately 40% of all accidents occur in, at or close to an inter-section [9]. This compares well with worldwide statistics [9, 10, 11, 12]. In 2001 the British Columbia Police reported these accidents constitute 44,1% of all accident types [11]. For this reason two of the typical causal scenarios resulting in intersection accidents will be analyzed to show that both the eagle eyed and the blind or a combination thereof is of absolute zero assistance to prevent an accident from occurring. Note that the mathematical analysis can be applied to numerous other intersection related accident scenarios as well as head-to-rear and multiple vehicle highway accidents. The purpose of the analysis is to introduce the reader to the concept of driver view field analysis to gain some understanding to what extent visual acuity and visual field can or cannot assist in the prevention of accidents.

Restricted Vision Line Angled Across Intersection

Figure 1 illustrates a common situation found at one or more corners of an intersection when building construction is in process. Legislation in respect of construction site safety typically requires the erection of safety fencing on the edge of pedestrian walks and on occasion, right on the road-edge.

Common practice is to utilize corrugated sheets which completely obstruct visual line diagonally across the intersection up to a critical point. We refer to such fencing as solid fencing. Figure 1 depicts a vehicle modeled as a point travelling at speed $v_1 > 0\ ms^{-1}$ following a line of travel parallel along the street hence, parallel to along the street hence, parallel to the solid fencing. The perpendicular separating distance between the line of travel and the solid fence is given by $\ell_1 \geq 0$.

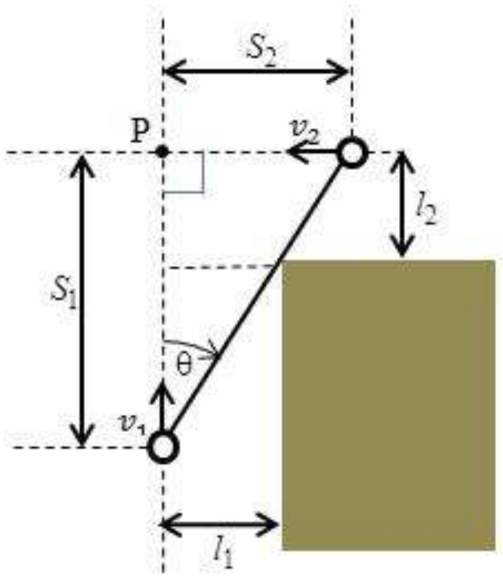

Figure 1.

Similarly, a second vehicle travelling perpendicular to the direction of travel of the first, at speed $v_2 > 0\, ms^{-1}$ and separated by distance $\ell_2 \geq 0$ from its corresponding solid fence applies.

Let both drivers be ignorant to the risk of the situation and assume both will drive through the intersection either just hoping for the best or, that they solely depend on eye sight to timeously alert them of eminent danger to which they must react.

The critical positions both vehicles must reach respectively to open the earliest opportunity for a direct line of sight (angled "across") are indicated in figure 1. Clearly after the respective vehicles travelled distances S_1 and S_2 an accident might occur. The occurrence is guaranteed (completely inevitable) if the travelling time to cover S_1 and S_2 by the respective vehicles are equal. It simply means that both vehicles have reached the same point P at exactly the same time, $t > 0$. In physics such occurrence is called a collision.

We have that:

$$tan\theta = \frac{\ell_1}{S_1 - \ell_2} = \frac{v_2 t}{v_1 t},$$

$$\therefore S_1 - \ell_2 = \frac{v_1 \ell_1 .t}{v_2 .t},$$

$$\therefore S_1 = \frac{v_1 \ell_1 + v_2 \ell_2}{v_2},$$

$$\therefore v_1 t = \frac{v_1 \ell_1 + v_2 \ell_2}{v_2},$$

$$\therefore t = \frac{v_1 \ell_1 + v_2 \ell_2}{v_1 v_2}.$$

Hence, what is fact is that the time from the moment the direct line of sight opens up to reaching the point of collision is a function of only the respective speeds and the separating distances from the respective solid fences. Because a driver can only control his/her travelling speed and not the speed of the other driver, an accident is inevitable if time t (constant for both drivers) is such that $t \leq t_0$, $t_0 > 0$ the accepted average human reaction time. No degree of good or poor vision fitness can mitigate this inevitable situation. Neither can vision impairment contribute causally to the accident as a physical science event. In fact, in litigation the principle of keeping a proper lookout or the failure to do so cannot objectively be applied. Only intuitive appreciation of the danger posed by the visual obstruction followed by the foreseeability of an accident and subsequent reduction in speed, which is not a function of visual parameters, to allow at least $t > t_0$ can possibly prevent an accident. The reason why travelling time exceeding human reaction time is not necessary sufficient to prevent an accident is because, if motion time (now including evasive action such as braking or swerving) remains equal for both vehicles to reach a common point, a collision occurs. It will only be that the point of impact, the nature of impact and the respective speeds at which impact occur, differ. Furthermore, a vehicle is not a true point but a dimensional structure hence the time at which the collision might occur is at $t' \in [t-\delta, t+\delta]$.

From the above model it is easy to see that visual obstruction can be temporary and in motion itself. For example passing a bus or an articulated vehicle serves as a temporary visual obstruction for a finite time measure. However, when the direct line of sight reopens the situation can be eminent danger despite the best or the worst vision fitness of the driver(s). Another very practical scenario is the tragic accidents resulting from a driver approaching a stationary bus from which commuters exit. If the driver does not foresee the possibility that a pedestrian can unexpectedly dash from "behind" the bus the analysis above applies. This is the reason why drivers are made aware to take extra precaution when approaching a stationary school bus. Young children cannot comprehend the danger and the principle should be explained to learner drivers. The authors are not aware of a curriculum explaining this principle

The 'Can Stop-Can Run'; 'Cannot Stop-Cannot Run' Dilemma

The third author presented most of this section during the 3rd International Conference on Accident Investigation, Reconstruction, Interpretation and the Law, during October 1999 [10]. Assume a driver travels at a constant speed $v > 0\ ms^{-1}$ along a road approaching an intersection with an across width of $\ell \geq 0$ meters. Assume that at distance $D \geq 0$ meters from the stop line the traffic lights switch to amber. The driver may after reaction time $\gamma > 0$ lapsed either run through the intersection safely if the distance ($D+\ell$) meters can be covered before the traffic lights switch to red or, stop safely if the vehicle stops within ($D - v\gamma$) meters. Figure 2 depicts the scenario.

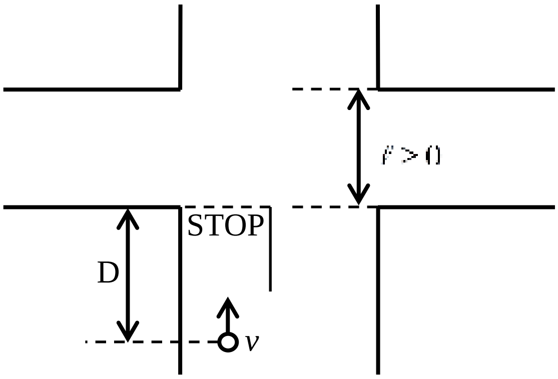

Figure 2.

A conservative assumption would be to consider running through without further acceleration. Therefore, to run safely through the intersection the inequality $vT \geq D+\ell, T>0$ seconds denotes the amber time. The minimum stopping distance utilizes full the friction coefficient say, μ . The minimum stopping distance corresponds to:

$$S = v\gamma + \frac{v^2}{2g\mu} \text{ meters, } g = \textit{gravitational acceleration}.$$

For safe stopping hence, outside the boundaries of the intersection either the inequality:

$$S = v\gamma + \frac{v^2}{2g\mu} \le D \ ,$$

or the inequality:

$$S = v\gamma + \frac{v^2}{2g\mu} + \ell \le D + \ell$$

must be satisfied. A potentially dangerous situation arises if, $v\gamma + \frac{v^2}{2g\mu} + \ell > vT$.

In fact, if $v\gamma + \frac{v^2}{2g\mu} + \ell > D + \ell > vT$, the driver can neither run through safely nor stop safely. This situation is the real dilemma. This dilemma occurs when:

$$v < (T-\gamma)g\mu - \sqrt{g^2\mu^2(\gamma - T)^2 - 2g\mu\ell} \ \textbf{or}$$

$$v > (T-\gamma)g\mu + \sqrt{g^2\mu^2(\gamma - T)^2 - 2g\mu\ell} \ .$$

Most drivers have experienced this unpleasant situation where, after harsh braking the vehicle skids to a standstill somewhere within the intersection. The vehicle must then either be reversed to a safe position or cross traffic must allow the driver to clear the intersection. A safe situation prevails if:

$$v\gamma + \frac{v^2}{2g\mu} + \ell \le vT.$$

If $D + \ell \ge vT$, the driver can and <u>must</u> stop. Attempting to run is a risk. If $D + \ell \le v\gamma + \frac{v^2}{2g\mu} + \ell$, the driver can and <u>must</u> run. Attempting to stop is a risk. If, $D + \ell \le v\gamma + \frac{v^2}{2g\mu} + \ell \le vT$, the driver can do either, safely.

Since stopping distance is a quadratic function of speed, whilst running distance is a linear function of speed, there are critical speeds at which stopping distance exceeds running distance and a hazardous situation may arise. It is not uncommon for drivers to occasionally find themselves in a critical position where, even with added acceleration late running is required to clear an intersection. The analysis shows undoubtedly that vision fitness or lack thereof alone cannot be a critical causal or preventative factor in accidents resulting from these dilemmas. These dilemmas require good vision with the skill of good judgment to mitigate. Some of the dilemmas are so critical per se that they present an inevitable consequence.

In [4] a total of 5471 crashes for the period June 2005 to December 2007 were analyzed in well-defined detail. It was found that measured against the categories performance/non-performance errors and decision/recognition errors, these errors by drivers were the critical pre-crash factors in 92,9 % of the crashes.

Analysis of Historical Eye-Testing Data

Since this was purely a desk-top research project there is no ethical conflict with the Helsinki Declaration. Note that the data is stratified such that it is not personalized. Hence, the data *per se* and the analysis thereof fully comply with the Protection of Personal Information Act, (Act 4 of 2013) of the Republic of South Africa [13]. Historical data of 3200 applicants for renewal of their driving licenses were randomly selected through stratified sampling as follows:

(i) In the Gauteng Province the driving license testing centres (DLTC's) within the City of Tshwane (CoT) were selected. The following stratified sampling applied. Rayton DLTC: 400 applicants randomly selected over the period January to March 2014; Bronkhorstspruit DLTC: 400 applicants randomly selected over the period May to July 2015; Waltloo DLTC: 800 applicants randomly selected over the periods January to March 2015 and August to October 2015; Akasia DLTC: 800 applicants randomly selected over the period May to September 2015; Centurion DLTC: 800 applicants randomly selected over the period November 2015 to February 2016. Accumulatively over the said periods an estimated 20 000 applicants renewed their driving licenses. The sample is of formidable size and the data inputs are binary in nature. This implies that ratio analysis is all that is required to derive extremely reliable results.

(ii) Age of applicant was approximated to the age reached in 2016. The formula used is: 2016 - 19$\langle x_1, x_2 \rangle$, $\langle x_1, x_2 \rangle$ are the first two digits of the applicant's South African Identity Number.

The age ranges were: R-1 = [18-25] years; R-2 = [26-35] years; R-3 = [36-45] years; R-4 = [46-55] years; R-5 = [56-65] years; R-6 = [66-75] years; R-7 = [76-85] years.

(iii) Driving license codes were categorized as: Cat-1 = {Code A1/A only}; Cat-2 = {Code B or EB only}; Cat-3 = {Code B or EB and A1/A}; Cat-4 = {highest Code C1 with (A1/A optional)}; Cat-5 = {highest Code C with (A1/A optional)}; Cat-6 = {highest Code EC with (A1/A optional)}.

(iv)The first eye-test event i.e. (a) eye-test failed; (b) eye-test passed; (c) optometrist or ophthalmologist (oculist) certificate presented on application date. Important to note is that amongst those who failed the eye-test, a subsequent pass after visiting an optometrist for a second and final result, was not captured. It implies that the fail ratio represents an upper bound (worst case in respect of eye-test pass rate).

Clearly a variation in calendar periods from which the samples were randomly selected are not of thematic significance. However, the data in respect of gender, driving license code, approximation of age and the eye-test event are of binary truth value and of thematic significance, and therefore data capturing in respect of this data was verified by random recapturing of 800 (25%) of the sample population. A total of 7 errors were detected of which 4 were age errors and 3 were errors in the data population. This implies that the probable error margin is $\frac{x}{3200} \approx \frac{7}{800} \Rightarrow x = 44.8(45)$ errors in the data population. After correcting the detected errors it is probable that a further $\approx$37,8 (38) errors may remain implying an error margin of $\approx$[1,1813 to 1,1875]%: Therefore the data integrity is considered sufficient to proceed with formal data analysis.

Some Important Findings

In this subsection the data for each DLTC will be analyzed individually where-after an accumulative analysis is presented. The authors' proposition is that the DLTC's within the City of Tshwane are most popular throughout the Gauteng Province. Perhaps it is correct to state that the Centurion, Akasia and Waltloo DLTC's are most popular in the country. It is therefore assumed that the study within the jurisdiction of the CoT is representative of the status quo in the Gauteng Province. It is envisaged to further this research through comparative studies throughout all nine provinces of the Republic of South Africa. Similar to the sample size selected for the City of Tshwane, formidable sample size will be selected from a main city in each of the eight other provinces.

Table 1. Centurion DLTC

Age Range	Male	Female	Cat-1	Cat-2	Cat-3	Cat-4	Cat-5	Cat-6	Pass	Cert	Fail
R-1: 107	48	59	6	94	1	6	-	-	105	2	-
R-2: 249	137	112	-	205	12	32	-	4	204	39	6
R-3: 213	114	99	5	142	26	30	-	10	194	19	-
R-4: 116	52	64	2	88	8	4	-	14	92	24	-
R-5: 74	46	28	-	48	8	4	-	14	54	14	6
R-6: 28	4	24	-	28	-	-	-	-	18	10	-
R-7: 13	7	6	-	10	3	-	-	-	9	2	2
Total: 800	408	392	13	615	58	76	-	42	676	110	14

Note that:

(i) Only 1,75% of applicants failed the prescribed visual acuity test.

(ii) Cat-2 (Code B or EB) is the most popular renewal category (76,875%) at the Centurion DLTC.

(iii) Cat-5 (highest Code C with (A1/A optional)) has no representation.

(iv) 89,47% of Cat-4 (Code C1) subsample are in the R-1 to R-3 age range.

(v) We observe noticeable lower renewal numbers (7,125% of sample) from the age 56 years and older.

(vi) Gender renewal ratio Male: Female = 51%: 49%.

Table 2. Rayton DLT

Age Range	Male	Female	Cat-1	Cat-2	Cat-3	Cat-4	Cat-5	Cat-6	Pass	Cert	Fail
R-1: 61	37	24	-	53	-	5	-	3	61	-	-
R-2: 116	87	29	-	81	-	32	-	3	116	-	-
R-3: 69	40	29	-	21	-	43	-	5	69	-	-
R-4: 69	48	21	-	45	-	21	-	3	64	5	-
R-5: 37	29	8	-	26	-	3	-	8	32	5	-
R-6: 27	16	11	-	22	-	-	-	5	22	5	-
R-7: 21	13	8	-	21	-	-	-	-	15	3	3
Total: 400	270	130	-	269	-	104	-	27	379	18	3

Note that:

(i) Only 0,75% of applicants failed the prescribed visual acuity test.

(ii)Cat-2 (Code B or EB) is the most popular renewal category (67,25%) at the Rayton DLTC.

(iii)Cat-5 (highest Code C with (A1/A optional)) has no representation.

(iv)76,92% of Cat-4 (Code C1) subsample are in the R-1 to R-3 age range.

(v)We observe noticeable lower renewal numbers (14,5% of sample) from the age 56 years and older.

(vi) Gender renewal ratio Male: Female = 67,5%: 32,5%.

Table 3. Bronkhorstspruit DLTC

Age Range	Male	Female	Cat-1	Cat-2	Cat-3	Cat-4	Cat-5	Cat-6	Pass	Cert	Fail
R-1: 87	45	42	16	34	2	21	-	14	83	4	-
R-2: 160	110	50	8	28	-	84	-	40	158	2	-
R-3: 82	39	43	6	20	-	44	-	12	76	6	-
R-4: 36	8	28	2	10	-	18	-	6	32	4	-
R-5: 24	14	10	2	10	-	2	-	10	20	4	-
R-6: 9	4	5	-	7	-	-	-	2	5	4	-
R-7: 2	2	-	-	-	-	-	-	2	2	-	-
Total: 400	222	178	34	109	2	169	-	86	376	24	-

Note that:

(i) None (0,00%) of applicants failed the prescribed visual acuity test.

(ii) Cat-4 (Code C1) is the most popular renewal category (42,25%) at the Bronkhorstspruit DLTC.

(iii) Cat-5 (highest Code C with (A1/A optional)) has no representation.

(vi) 88,17% of Cat-4 (Code C1) subsample are in the R-1 to R-3 age range.

(v) We observe noticeable lower renewal numbers (8,75% of sample) from the age 56 years and older.

(vi) Gender renewal ratio Male: Female = 56,00%: 44,00%.

Table 4. Waltloo DLTC

Age Range	Male	Female	Cat-1	Cat-2	Cat-3	Cat-4	Cat-5	Cat-6	Pass	Cert	Fail
R-1: 91	63	28	1	54	24	8	-	4	72	16	3
R-2: 312	224	88	8	100	60	116	7	21	280	32	-
R-3: 165	120	45	8	68	16	33	12	28	133	30	2
R-4: 100	68	32	-	24	13	16	24	23	68	29	3
R-5: 76	69	7	-	31	-	13	-	32	68	7	1
R-6: 44	28	16	-	4	11	7	6	16	23	21	-
R-7: 12	12	-	-	4	-	-	8	-	12	-	-
Total: 800	534	266	17	285	124	193	57	124	656	135	9

Note that:

(i) Only 1,125% of applicants failed the prescribed visual acuity test.

(ii) Cat-2 (Code B or EB) is the most popular renewal category (35,625%) at the Waltloo DLTC.

(iii) 81,35% of Cat-4 (Code C1) subsample are in the R-1 to R-3 age range.

(iv) We observe noticeable lower renewal numbers (16,5% of sample) from the age 56 years and older.

(v) Gender renewal ratio Male: Female = 66,75%: 33,25%.

Table 5. Akasia DLTC

Age Range	Male	Female	Cat-1	Cat-2	Cat-3	Cat-4	Cat-5	Cat-6	Pass	Cert	Fail
R-1: 47	31	16	-	32	-	15	-	-	43	4	-
R-2: 208	100	108	2	124	21	61	-	-	197	9	2
R-3: 209	128	81	-	101	40	68	-	-	191	17	1
R-4: 140	80	60	-	48	44	27	1	20	120	20	-
R-5: 133	75	58	4	85	28	4	4	8	83	49	1
R-6: 39	22	17	-	19	8	4	8	-	27	10	2
R-7: 24	16	8	-	20	4	-	-	-	8	16	-
Total: 800	452	348	6	429	145	179	13	28	669	125	6

Note that:

(i) Only 0,75% of applicants failed the prescribed visual acuity test.

(ii) Cat-2 (Code B or EB) is the most popular renewal category (53,625%) at the Akasia DLTC.

(iii) Cat-5 (highest Code C with (A1/A optional)) has some presence (1,5%).

(iv) 80,45% of Cat-4 (Code C1) subsample are in the R-1 to R-3 age range.

(v) We observe noticeable lower renewal numbers (24,5% of sample) from the age 56 years and older.

(vi) Gender renewal ratio Male: Female = 56,5%: 43,5%.

Table 6. Accumulative Data Table

Age Range	Male	Female	Cat-1	Cat-2	Cat-3	Cat-4	Cat-5	Cat-6	Pass	Cert	Fail
R-1: 393	224	169	23	267	27	55	-	21	364	26	3
R-2: 1045	658	387	18	538	93	325	7	68	955	82	8
R-3: 738	441	297	19	352	82	222	12	55	663	72	3
R-4: 461	256	205	4	215	65	86	25	66	376	82	3
R-5: 344	233	111	6	200	36	26	4	72	257	79	8
R-6: 147	74	73	-	80	19	11	14	23	95	50	2
R-7: 72	50	22	-	55	7	-	8	2	46	21	5
Total: 3200	1886	1314	71	1707	329	721	70	307	2756	412	32

In summary note that:

(i) Most likely less than 1% of applicants finally fail the prescribed visual acuity test. The reason for this conclusion is because the data did not reflect those who failed an eye-test at a DLTC on first event and passed the eye-test at an optometrist as second event.

(ii) Cat-2 (Code B or EB) is the most popular renewal category (53,34%) overall.

(iii) Cat-5 (highest Code C with (A1/A optional)) is close to redundant as a heavy vehicle driving license category.

(iv) 83,495% of Cat-4 (Code C1) subsample are in the R-1 to R-3 age range.

(v) We observe noticeable lower renewal numbers (11,16% of sample) from the age 56 years and older.

(vi) Gender renewal ratio in the City of Tshwane Male: Female = 58,94%: 41,06%.

(vii) The Rayton DLTC shows distinct male applicant preference.

(viii) Bronkhorstspruit DLTC shows a perhaps questionable, 0% eye test failure rate.

Synopsis of Vehicle Population and Driving License Holders in South Africa

The most reliable source of the vehicle population in the South African context is e-NaTIS. The most recent published statistics to date (29 February 2016) confirms that Code B or EB is the minimum driving license requirement for 89,83% of registered motor vehicles (GVM 3500 kg). A further 6,05% comprises of motorcycles, quadru-cycles, tricycles and other self-propelled light vehicles. All other vehicles (GVM > 3500 kg) hence, < 4,1% require at least a Code C1 or higher driving license code.

The same statistics release indicates the following numbers per driving license code in Gauteng Province: Code A1 = 44706; Code A = 173290; Code B = 961450; Code EB = 1 313283; Code C1 = 1 116164; Code C = 4519; Code EC1 = 227126; Code EC = 294892. Clearly the 26,99% Code C1 driving license holders are disproportionate to the intended vehicle population (< 4.1%).

Conclusion and Further Research

The researchers are in agreement that vision fitness is of importance. However, research indicates the cognitive interpretation of visual stimuli is of greater importance. Legislation sets standards for visual acuity and visual field but ignores more important visual performance factors such as color vision, stereopsis (depth perception) and contrast sensitivity. In a recently published study by Boadi-Kusi et al. [5] it was concluded convincingly that comprehensive eye examination by appropriate professionals to detect conditions such as refractive errors, binocular vision anomalies and monocular blindness, is far more important than simply testing visual acuity as is currently the case.

The data analysis strongly suggests, almost in the absolute sense, that the current eye-testing protocol in the South African context is obsolete and it adds little value to driver fitness as a holistic concept. It is doubtful whether the current eye-tests have any deterministic relation as a meaningful causal factor in the catastrophic rate of serious/fatal/pedestrian accidents in South Africa. In practical terms it is required from license holders to spend long hours in service queues and in many instances it requires a revisit. Since the economic impact of the time wasted has not been assessed it offers scope for further research. Anecdotal evidence (complaints and public debate forums) suggests that for many drivers the waste of time is unaffordable. It is suggested that this is the single most important procedure preventing the elegant solution of on-line driving license card renewals. It is further suggested that if the current eye-test standards and protocol be sustained, that the acceptance of an optometrist certificate be promoted to minimise the number of those queuing for eye-tests at a DLTC.

A noticeable imbalance in the ratio of Code C1 license holders versus the vehicle population requiring that driving license code is observed. This observation raises the mysterious question for which a plausible answer should be researched. Why is it that so many decision makers and DLTC's claim the existence of a high demand for Code C1 driving license testing for a vehicle category < 4,1% of the vehicle population? Secondly, is there any correlation between the increasing number of Code C1 driving license holders and the carnage on South African roads? The respected digital research company, Pondering Panda, released a survey in May 2013 in which it reliably reported that corrupt driving license testing is rife in South Africa. In particular, Cat-4 is of interest because anecdotal evidence suggests strongly that Code C1 driving testing is the most corrupt driving testing code in the South African context.

With the observation that Code C is practically a redundant driving license category, it comes to mind that the deletion of Code C1 and C together with a prerequisite of compulsory Code B or EB with a minimum number of years driving experience prior to graduating to Code EC1 or EC could be a feasible intervention in reducing heavy vehicle accidents. The aforesaid is based on the well-known principle of induction skilling through repetition as stated in an ancient Latin proverb, '*Repetitio mater studiorum est*'. Hence, the proposal is based on the principle that developing comprehensive driving skills and the required cognitive skills while restricted to driving a light motor vehicle is likely to be, a safer option than developing same while driving heavy vehicles or an articulated tractor with interlinked trailers. An immediate intuitive challenge will be the resistance from the many existing driving schools specialising only in Code C1 instruction and testing. Perhaps, within the South African context, we have an example of an undesirable driving license category that cannot be corrected due to the anticipated civil unrest which might follow.

References

1. Coetzee versus Road Accident Fund (38098/2-12) [2014], ZAGPPHC 551, (8 August 2014).
2. Jacobs versus Road Accident Fund (A402/2008) [2011], ZAGPPHC 121, (13 June 2011).
3. Mmeti versus Road Accident Fund (2038/2008) [2011], ZANWHC 82, (3 February 2011).
4. B. Walston-Dunham, **Introduction to Law**, Fith Edition, Delmar, Cengage Learning.
5.S.B. Boadi-Kusi, S. Kyei, F.A. Asare, A. Owusu-Ansah, A. Awuah, C. Darko-Takyi, **Visual Function among Commercial Vehicle Drivers in the Central Region of Ghana**, Journal of Optometry, 9,2016, 54-63.
6. G.T.W. Cashell, **Visual Function in Relation to Road Accidents**, Injury: The British Journal of Accident Surgery, 2(1), July 1970, 8-10.
7. C. Owsley and G. McGwin Jr, Vision and Driving, **Vision Research**, 50(23), 2010, 2348-2361
8. National Road Traffic Act, (Act 93 of 1996), Republic of South Africa.
9. National Motor Vehicle Crash Causation Survey, NHTSA, Report to Congress, U.S. Department of Transport, (July 2008).
10. J. Kok, **On Traffic Light Controlled Intersection Accidents**, The 3rd International Conference on Accident Investigation, Reconstruction, Interpretation and the Law, Pretoria, South Africa, October 1999.
11. S.J. Laing, **A Study of Age Differences in Accident Rates at Intersections in British Columbia**, M.A. Thesis (Gerontology), Simon Fraser University, August 2003.
12. N.S.S.R. Murthy and R. Srinivasa Rao, **Development of model for road accidents based on intersection parameters using regression models**, International Journal of Scientific and Research Publications, 5(1), January 2015.
13. Protection of Personal Information Act, (Act 4 of 2013), Republic of South Africa

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[1] **Competing Interests:** The authors declare that they have no competing interests.
Author's Contribution: All the authors contributed significantly in writing this paper. The authors read and approved the final manuscript.

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