Technical Report Documentation Page

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9. Performing Organization Name and Address **ESRA Consulting Corporation** **1650 South Dixie Highway, 3rd Floor** **Boca Raton, Florida 33432** **(561) 361-0004** **http://www.esracorp.com**		10. Work Unit No. 11. Contract or Grant No. SPR-PL-1-(61) 559
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16. Abstract

This one-of-a-kind comprehensive study highlights the importance of automated testing techniques and the significance of vision screening measures other than standard visual acuity testing for assessing all drivers and, in particular, at-risk drivers and older drivers. Non-automated tests tend to be subjective, time-consuming, costly, and heavily reliant on the experience of the examiner. Due to the high collision, injury, and fatality rates of all drivers in the State of Arizona, and the disproportionate number of at-fault older drivers and collision risks in the States of Arizona and Florida, new and automated screening methodologies and vision standards are now needed to promote road safety, predict visual impairment, and evaluate possible restriction or confiscation of driver's licenses. This study demonstrates that environmental factors and manner of collisions increase in collision involvement for drivers between ages 50 to 59 years in both Arizona and Florida. Drivers age 80 to 89 years in both states are most likely at-fault in collisions compared to all other age cohorts. These results are consistent among drivers cited for collision involvement due to visual defects. Our findings, which span an 11- year period from 1991 to 2001, not only apply to Arizona and Florida, two states with some of the largest proportions of older individuals in the United States, but, as our global survey of motor vehicle bureau directors or their representatives of the United States, Commonwealth of Puerto Rico, United Kingdom, Canada, New Zealand, and Australia illustrate, any state, country, province, territory, commonwealth, or nation with an increasing number of older drivers. A pilot study, to follow, ultimately allows for the implementation of effective strategies for screening of visual impairment and eye disease in all Arizona drivers. Snellen acuity, the most widely used vision testing measure, accounts for less than 0.1 percent of the visual field and fails to quantify contrast sensitivity and color vision (Fink and Sadun, 2004), two of several visual parameters needed for safe driving. It is recommended that at-risk and older drivers in Arizona are tested for vision through a newly designed system of measures provided by two automated tests (to test vision condition and function) and one driving simulator (to assess eye status). Hence we integrate it into a larger system and provide additional recommendations as these relate to motor vehicle operation skills and cognition. These automated systems and methodologies may ultimately serve as a prototype of transportation license testing improvements for all other states, countries, and agencies (e.g., aviation, rail, maritime, commercial vehicles, etc.) to follow. Such techniques may also reduce the incidence of fraudulent schemes and issuances of driver's licenses, commercial driver's licenses, and hazardous materials transportation licenses.

17. Key Words	18. Distribution Statement	23. Registrant's Seal
older driver, at-risk driver, driver's license test, UFOV, RAIR, Relative Accident Involvement Ratio, probabilistic risk assessment, visual acuity, driving simulator, vision test, dementia, Alzheimer's Disease, Parkinson's Disease, Macular Degeneration, Arizona, Florida, ESRA Dynamic Vision Assessment for Transportation, license renewal, automated testing, vision screening system, ESRA DVAT, ESRA VAPT, ESRA Vision Assessment Procedure for Transportation, simulator sickness, flashback effect, aftereffect, cybersickness, ESRA DAT, driver license test procedure, transportation license test	Document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia, 22161	

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"New, Improved, Comprehensive, and Automated Driver's License Test
and Vision Screening System"
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I dedicate this report to the memory of Max, my grandfather, a pedestrian statistic. May this report serve as a testament to his legacy. He is sorely missed.

This one is for you, Papa.

SI (MODERN METRIC) CONVERSION FACTORS*

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
	AREA			
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yards	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
	VOLUME			
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: Volumes greater than 1000L shall be shown in m^3.			
	MASS			
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000lb)	0.907	megagrams (or "metric ton")	mg (or "t")
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5(F-32)/9 or (F-32)/1.8	Celsius temperature	°C
	ILLUMINATION			
fc	foot candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
	FORCE AND PRESSURE OR STRESS			
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
	LENGTH			
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
	AREA			
mm^2	Square millimeters	0.0016	square inches	in^2
m^2	Square meters	10.764	square feet	ft^2
m^2	Square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	Square kilometers	0.386	square miles	mi^2
	VOLUME			
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	Cubic meters	35.315	cubic feet	ft^3
m^3	Cubic meters	1.308	cubic yards	yd^3
	MASS			
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (or "metric ton")	1.102	short tons (2000lb)	T
	TEMPERATURE (exact)			
°C	Celsius temperature	1.8C + 32	Fahrenheit temperature	°F
	ILLUMINATION			
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
	FORCE AND PRESSURE OR STRESS			
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2