

The University of Technology, Sydney

Faculty of Science

**Measurement and Computational Analysis  
of Skin Conductance  
Under Repetitive Stimuli and in Different Age Groups**

Thesis in Science

By

Ilan Avshalom B.Des (Ind) (UTS), MSc (UTS)

Submitted in Fulfilment of the  
Requirement for the Degree of

Doctor of Philosophy  
In  
Science

2010



UNIVERSITY OF  
TECHNOLOGY SYDNEY

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Student's Name: Ilan Avshalom

## **ACKNOWLEDGMENTS**

A special thanks to Prof. Bessim Ben-Nissan for his time, encouragement and determination throughout the writing of this thesis. I would also like to thank the staff at the Science Faculty University of Technology, Sydney.

Particular thanks to Dr. Norman Booth for his contribution and advice in the design and construction of the conductance measurement system, and to Valerio Taraschi for his assistance and support with various aspects of the computational and statistical analysis

Thank you for all the patience shown to me from Dr. Tom Moss and Prof. Roy Bearn, and for their guidance and constant support.

Without the Australian Research Commission and UTS grants this thesis may never have been completed.

Finally, a very special thank you to my three girls, Ilijana, Nadja and Gaija and my special wife Lee, whose constant encouragement and support allowed me to finish this thesis free of worries.

## **ABSTRACT**

In this work skin conductance measurement was used to investigate a number of aspects of response to repetitive audiovisual stimuli and at different age group subjects. Stimuli were induced with a range of film clips generating emotions and an audiovisual computer generated segment to investigate repetitive stimulation and resultant response. Past skin conductance experimental measurements indicate that a number of specific factors can influence the results. These factors include: electrode type and placement, sensitivity, resolution of the equipment, areas covered by the electrodes, skin temperature and experimental environmental conditions to name just a few.

The electrode placement and recording site used in this work is based on the understanding that maximum neural innervations occur where the ring finger is innervated with both ulnar and median nerves. This was critically important when measured and calculated parameters of skin conductance such as latency, amplitude, response rate and duration of multiple stimulus sequence responses were investigated.

An advanced portable skin conductance device was developed for biomedical application. An audiovisual computer program was prepared for optimisation of the biomedical application and the verification of the results . Repetitive multiple stimuli were introduced sequentially within this video clip that utilised a crashing glass sound to generate excitation. Results were plotted for 21 subjects in two separate experiments using this multiple stimuli. After measuring the skin conductance data, amplitude (intensity), latency (response time, delay), reaction rates (gradient of the rise), and the response length were calculated and statistical analysis carried out.

The results showed that during three repetitive multiple stimulus, after a non action period if a crashing sound was introduced, a decrease in the amplitude of the skin conductance was observed, in contrast the latency or delay in reaction

time was increased with each repetitious stimuli, and the reaction rate for each stimuli was very close for each of the three consecutive crashes.

For the analysis of continuous stimulation, five film segments were used and measured skin conductance parameters were again analysed. A detailed statistical analysis was carried out for one of the film segments and analysis was applied to 59 subjects that were grouped according to their age distribution and grouping. The results showed a good correlation of the groupings and it was determined that with increased age, skin conductance is reduced.

This verification results showed that a reliable audiovisual stimulation may assist with subjects maintaining focus. The results also showed that attention may act as a filter for the response minimizing spontaneous sudomotor reflexes that enable the study of repetitive stimulus of oddball paradigm.

The results validate the effectiveness of the developed device and indicate that under controlled conditions, multiple sequential stimuli might initiate brain-to-skin conductance path might be crucial in controlling responsive psychological stimuli and possibly its clinical applications such as control of epileptic seizure and its use as early seizure warning device.

To understand the brain pathways and the reaction mechanisms of the emotional stimuli, future work utilising this device, with functional magnetic resonance imaging and other classic medical monitoring equipment such as the EEG is recommended.

## TABLE OF CONTENTS

CERTIFICATE OF ORIGINALITY .....	II
ACKNOWLEDGMENTS .....	III
ABSTRACT .....	IV
TABLE OF CONTENTS .....	VI
LIST OF FIGURES .....	IX
LIST OF TABLES .....	XII
APPENDICES .....	XIII
ABBREVIATIONS .....	XIV
1.0 INTRODUCTION .....	2
1.1 Significance.....	2
1.2 Historical Overview .....	3
1.3 Aims and Objective .....	5
1.4 Thesis Outline .....	5
1.4 References.....	8
2.0 LITERATURE REVIEW .....	11
2.1 Skin Anatomy and Physiology .....	11
2.2 The sweat glands.....	13
2.2.1 The structure of the Eccrine gland .....	14
2.2.2 Sweat secretion and reabsorption.....	16
2.3 Neural Pathways.....	17
2.3.1 Sympathetic nervous system .....	19
2.3.2 Parasympathetic nervous system .....	22
2.3.3 Cutaneous innervation of the Skin .....	25
2.3.4 Electrical Properties of the Skin .....	27
2.4. Repeated Stimulus and Orienting Response.....	29

2.5	Electrodermal Activity (EDA).....	30
2.5.1	Electrode sites and area of contact.....	34
2.5.2	Parameters of skin conductivity .....	38
2.5.3	Factors affecting the EDA.....	39
2.5.4	Electrodermal Activity and Age Factor .....	41
2.5.5	Electrodermal Activity and Behavior .....	42
2.5.6	Electrodermal activity and emotion. ....	43
2.5.7	Electrodermal activity and performance.....	44
2.5.8	Electrodermal activity and mental activity. ....	45
2.5.9	Electrodermal activity and psychopathology .....	46
2.6	Summary and study rational .....	48
2.7	References.....	50
3.0	DEVELOPMENT OF THE DEVICE: DESIGN, EXPERIMENTAL METHODS AND OPTIMISATION .....	62
3.1	Introduction .....	62
3.2	Sensor and Amplification .....	64
3.3	Calibration and sensitivity verification of portable system.....	67
3.4	Preliminary recordings of conductance measurement.....	69
3.5	Calibration and verification of final design .....	71
3.6	Electrodes and placement .....	74
3.7	Stimulus Generation .....	75
3.7.1	Audio visual stimulation 1 .....	76
3.7.2	Audio visual stimulation 2 .....	77
3.8	References.....	77
4.0	INVESTIGATION OF THE REPETITIVE STIMULI.....	80
4.1	Introduction .....	80
4.2	Subjects .....	81
4.3	Procedure .....	81
4.4	Computational and Statistical Analysis.....	83
4.5	Results and discussion .....	85

4.5.1	Response Times (Delay/ Latency) .....	88
4.5.2	Amplitude (Intensity of Conductance) .....	92
4.5.3	The Reaction rate (Rise/Slope).....	94
4.5.4	“Habituation” (Duration of response).....	96
4.6	Further Discussion .....	100
4.7	References.....	104
5.0	EFFECT OF DIFFERENT AGE GROUPS .....	106
5.1	Introduction .....	106
5.2	Experimental Procedure .....	107
5.2	Subjects .....	109
5.4	Computational and Statistical Analysis .....	109
5.5	Results and discussion .....	111
5.5.1	Selection of segment for analysis .....	113
5.5.2	Age group correlations .....	115
5.6	Further Comments .....	121
5.7	References.....	122
6.0	MAJOR FINDINGS AND CONCLUDING REMARKS .....	126
6.1	Major Findings .....	126
6.2	Concluding Remarks.....	126
7.0	FUTURE CONSIDERATIONS.....	131
7.1	Application as epileptic seizure warning device.....	131
7.2	Suggested Future Work .....	135
7.3	References.....	137



## LIST OF FIGURES

Figure 2.1	Cross section of the human skin as a layered structure and its organs (adapted from Skokie 1993).	12
Figure 2.2	The structure of the eccrine sweat gland (adapted from Boucsein 1992).	15
Figure 2.3	Sympathetic and parasympathetic branch of the ANS (adapted from Britannica 2007).	20
Figure 2.4	Suggested route of sweat gland activation. 1: limbic system via hypothalamus. 2: influences from premotor cortex and basal ganglia areas (adapted from Boucsein 1992).	25
Figure 2.5	Cutaneous division of palmar and the dorsale parts of the skin; innervation of ulnar radial and median nerve fibres.	26
Figure 2.6	Schematic outline of the cognitive-autonomic interactive model proposed by Ohman (1992). Adapted from Oman 1992).	29
Figure 2.7:	Basic circuit diagram of constant current (A) and constant voltage (b) measuring techniques (adapted from Lykken & Venables 1971).	33
Figure 2.8:	Distribution of sweat on the palm and suggested sites for exosomatic recording. (Adapted from Kuno 1956).	36
Figure 2.9:	SCR waveform (Adapted from Martin and Venables 1980).	39
Figure 3.1	Block diagram of the skin conductance measurement system and the following stages of method.	63
Figure 3.2:	Circuit board design for sensing and amplifying conductance measurements.	66
Figure 3.3:	Data logger (left) and sensing and amplification circuit, power supply, electrode input and circuit output (right).	68
Figure 3.4:	Calibration curve of skin conductance amplifier, single channel, based on 8 resistors input.	69
Figure 3.5	Voltage output recording ( $V_{out}$ vertical) of a subject while riding a motorbike and a visit to a dentist for dental treatment, horizontal axis - time line.	70
Figure 3.6:	Final design of 4 channel data amplifier (bottom) and	72

	recorder/ logger (Top - Velleman Instruments, PCS10, Belgium).	
Figure 3.7:	Calibration curve of skin conductance amplifier, 4 channel, based on 6 resistors input.	73
Figure 3.8:	Conductance measurement system and palmar recording site.	75
Figure 4.1:	Block diagram of repetitive stimuli experimental procedure.	80
Figure 4.2:	Repetitive stimuli - experiment setup.	83
Figure 4.3:	Skin conductance against time in seconds. The three peaks represent three consecutive crashes and related changes observed.	88
Figure 4.4:	The delay (latency) at first and second stimulus. Subject numbers are reported on the horizontal axis while response times (sec) are given on the vertical axis.	89
Figure 4.5:	Response times (delay, latency) for 5 subjects under 3 consecutive crashing sounds at constant ITI.	90
Figure 4.6:	Intensity excursion for 6 subjects after 3 repetitious stimulus	93
Figure 4.7:	A graph of the 6 subjects showing that the value of the slope (reaction rate) is nearly the same for each subject for the 3 stimuli used.	95
Figure 4.8:	Skin conductance values against time. Time interval between two subsequent stimuli is 40 sec. The second peak shows the total integration from the baseline while the third one demonstrates what we meant in the analysis for "half peak integration".	97
Figure 4.9:	Correlation values (reported on the top right of the graphs) and comparison between the Intensities and the areas: (a) half response (partial integral) and (b) full integration.	98
Figure 4.10	Reaction duration as a function of area calculation, for three stimuli subjects 1 to 6.	99
Figure 5.1:	Block diagram of experimental work, emotional stimulation and SC.	106
Figure 5.2:	The graph shows for selective three subject conductance amplitude(y) Vs movie timeline(x). Dotted line represents movies sequence 1 to 6 with intervals. (3 subjects conductance measurements ranged between 2 to 25 $\mu$ mho)	113

Figure 5.3 Calculated response range (x) of 59 subjects for 6 115  
sequential emotional stimuli (y).

Figure 5.4 Calculated conductance baseline values of 5 age groups 119  
(age 20-65) plotted against group's age (Correlation  
coefficient: -0.67). The slope of the best linear fit computed  
with Gnuplot for the data is displayed on the graph itself.

Figure 5.5: Maximum skin conductance amplitude of 5 age groups (age 120  
20-65) plotted against group's age (Correlation coefficient: -  
0.83). The slope of the best linear fit computed with Gnuplot  
for the data is displayed on the graph itself.

## LIST OF TABLES

Table 1:	Circuit calibration table single channel system.	68
Table 2:	Circuit calibration table 4 channel system.	72
Table 3:	Summary of the quantities computed by the algorithm on the conductance profiles for the experiment with 14 subjects and two audio stimuli.	86
Table 4:	Summary of the quantities computed by the algorithm on the conductance profiles for experiment with six subjects and three audio stimuli.	86
Table 5:	Values of the Delay Time (sec), Intensity ( $\mu\text{Mho}$ ) and Response Rate ( $\mu\text{mho}/\text{sec}$ ) and the standard deviation ( $\sigma$ ) of the response rate of the three simultaneous simulations for 3 different participants.	94
Table 6:	Area calculation described as stimulus reaction duration for three stimuli of subject 1 to 6 and percentage reduction between 1st and 2nd stimuli.	99
Table 7:	Correlation coefficients calculated for the series of data regarding baseline and maximum value of skin conductivity. The four different series are relative to the 4 different age intervals used for grouping the subjects.	117

## APPENDICES

Appendix A - Consent form	139
Appendix B - Subjects details	140
Appendix C - Movie list	141
Appendix D - Results: experiment	142
Appendix E - Results: Experiment 2	144

## **ABBREVIATIONS**

Ach – Acetylcholine

ADC – Analogue to Digital Conversion

ANS – Autonomic Nerves System

BOLD – Blood Oxygenation Level-Dependent

CNS – Central Nervous System

EDA – Electro Dermal Activity

EEG – Electroencephalography

FMRI – Functional Magnetic Resonance Imaging

FPS – Frames Per Second

GSR – Galvanic Skin Response

ITI – Inter Trial Intervals

OR – Orienting Response

PNS – Peripheral Nervous System

PSI – Palmar Sweat Index

SCL – Skin Conductance Level

SCR – Skin Conductance Response

SD – Standard Deviation

SPL – Skin Potential Level

SPR – Skin Potential Response

SRL – Skin Resistance Level

SRR – Skin Resistance Response