**EMOTIONAL INTELLIGENCE DRIVEN QUALITATIVE MARKET RESEARCH TECHNIQUES:
AN EXPLORATORY STUDY**

**Submitted in fulfilment of the requirements**

**for the award of the**

**Doctor of Philosophy**

**By**

**MANISH SHARMA**

2K12/PHDDSM/01

**UNDER THE GUIDANCE OF**

**DR. SHIKHA N KHERA PROF. P. B. SHARMA**

Assistant Professor Vice Chancellor

Delhi School of Management Amity University Haryana



**DELHI TECHNOLOGICAL UNIVERSITY**

**BAWANA ROAD, DELHI-110042**

**JUNE 2020**

**COPYRIGHT NOTICE**

© DELHI TECHNOLOGICAL UNIVERSITY, DELHI 2020

ALL RIGHTS RESERVED

**CANDIDATE'S DECLARATION**

I, hereby certify that the thesis titled **"Emotional Intelligence Driven Qualitative Market Research Techniques: An Exploratory Study"** is submitted in fulfilment of the requirements for the award of the degree of Doctor of Philosophy and is an authentic record of my research work carried out under the guidance of Dr. Shikha N. Khera and Prof. P. B. Sharma. Any material borrowed or referred to is duly acknowledged.

The content of this thesis has not been submitted elsewhere in part or fully to any other school, institute or university for the award of any degree.

**Manish Sharma**

2K12/Ph.D/DSM/01

Delhi School of Management

Delhi Technological University

**SUPERVISOR'S CERTIFICATE**

"This is to certify that the thesis titled **"Emotional Intelligence Driven Qualitative Market Research Techniques: An Exploratory Study",** submitted in fulfilment of the requirements for the award of the degree of Doctor of Philosophy is an original research work carried out by Mr. Manish Sharma, under our supervision. The content of this thesis has not been submitted elsewhere in part or fully to any other University or Institute for the award of any degree, to the best of our knowledge."

**Dr. Shikha N Khera Prof. P.B. Sharma**

Assistant Professor Vice Chancellor

Delhi School of Management Amity University Haryana

**Acknowledgement**

It was in 2012 when I joined the Ph.D. programme and started my research under the guidance of Dr. Shikha N. Khera and Prof. P.B. Sharma. I thank god for giving me this opportunity to learn & grow and build my career this way. I would like to express heartfelt gratitude to my guides for their constant support and encouragement that helped me to stay focused and strive for more. I would also like to thank the Head of Department, Dr. Rajan Yadav, who has always been a pillar of support and all the faculty members of the department who encouraged to think beyond the boundaries. I would also like to thank all my fellow scholars and friends that without their support, this would have been an impossible task. I would especially like to thank the library committee and the admin committee for all their support.

A special thanks to my family that they supported my decision of pursuing a Ph.D. and extended constant help in all the ways in completing the Ph.D.

**TABLE OF CONTENT**

***Title Page No.***

**Chapter 1: INTRODUCTION 1-10**

 1.1 Defining and Classifying Emotional Intelligence 1

 1.2 Market Research 2

 1.2.1 Definition 2

 1.2.2 Classification 2

 1.3 Qualitative Market Research Techniques 2

 1.3.1 Focus group 3

 1.3.2 Ethnography 4

 1.3.3 In-depth interview 4

 1.4 Background Information 4

 1.5 Scope of the Study 6

 1.6 Orientation of the Study 7

 1.8 Chapter Outline 8

**CHAPTER 2: LITERATURE REVIEW 11-72**

2.1 Literature in areas of Emotional Intelligence 11

2.2 Tests for measurement of Emotional Intelligence 13

 2.2.1 Mayer-Salovey-Caruso Emotional Intelligence Test 13

 2.2.2 Trait Meta-Mood Scale 16

 2.2.3 Wong and Law Emotional Intelligence Scale 18

 2.2.4 Wong's Emotional Intelligence Scale 20

 2.2.5 Tapia Emotional Intelligence Inventory 22

2.2.6 Schutte Self Report Emotional Intelligence Test 25

2.2.7 Emotional Competence Inventory 2.0 27

2.2.8 Emotional Skills Assessment Process 29

2.2.9 Emotional Quotient Inventory 32

2.2.10 Dulewicz & Higgs Emotional Intelligence Questionnaire 35

2.2.11 EQ Map of Cooper and Sawaf 37

***Title Page No.***

2.2.12 Trait Emotional Intelligence Questionnaire 39

2.2.13 Genos Emotional Intelligence Inventory 42

2.2.14 Group Emotional Intelligence Survey 44

 2.2.15 Positive and Negative Affect Schedule 46

2.2.16 Wechsler Abbreviated Scale of Intelligence, Second Edition 48

2.2.17 Sixteen Personality Factors(16PF) Test 50

2.2.18 Myers-Briggs Type Indicator 53

2.2.19 Belbin Team Role Inventory 55

2.2.20 Leadership Practice Inventory 57

2.2.21 Multifactor Leadership Questionnaire 60

 2.3 Machine Learning 64

2.3.1 Classifiers 65

2.3.2 Machine Learning and Regression using Neural Network 68

2.3.3 Feature Selection and Reduction 70

**CHAPTER 3: RESEARCH OBJECTIVES & HYPOTHESIS 73-75**

3.1 Research Objectives 73

3.2 Hypothesis 73

3.3 Conceptual Framework: 74

**CHAPTER 4: RESEARCH METHODOLOGY 76-83**

4.1 Universe and Survey population 76

4.2 Sampling technique 76

4.3 Sample Size 76

4.4 Variables 76

4.5 Data collection 77

 4.5.1 Data for emotion detection from images 77

 4.5.2 Data for selecting the most important features and regression using ML 78

4.6 Data pre-processing and analysis 79

4.6.1 Pre-Processing of data 79

***Title Page No.***

4.6.2 Data Analysis 79

4.7 Support Vector Machine for classifying images based on emotions 81

4.8 Neural Networks for regression to find missing data 82

**CHAPTER 5: EXPERIMENT, OBSERVATION AND ANALYSIS OF DATA TO AUTOMATE THE MEASUREMENT OF EMOTIONAL INTELLIGENCE 84-106**

5.1 Experimental results on the detection of emotions from the facial images 84

5.2 Use of images data to establish that emotional intelligence plays a role in qualitative market research techniques 88

5.3 Experiment and observation for feature selection and regression of text data to find the essential features of the TMMS test of Emotional Intelligence measurement 89

5.4 Feature selection to find the essential features of emotional intelligence 92

5.5 Regression to find missing data out of emotional intelligence measurement test 94

**CHAPTER 6: CONCLUSION AND CONTRIBUTION OF STUDY 107-108**

**CHAPTER 7: RECOMMENDED STRATEGIES FOR THE MEASUREMENT OF EMOTIONAL INTELLIGENCE 109**

**CHAPTER 8: IMPLICATIONS OF STUDY 110-111**

 8.1 Industry 110

 8.2 Academia 111

**CHAPTER 9: LIMITATION AND FUTURE SCOPE OF STUDY 112**

**10. REFERENCES 113-125**

**APPENDIX A 126-127**

**LIST OF FIGURES**

***Figure No. Page No.***

Figure 1 : Research Workflow 1

Figure 2 : Single Layer Feed Forward 66

Figure 3 : Multilayer Feed Forward 66

Figure 4 : Pipeline to find the essential feature out of Emotional Intelligence measurement test 74

Figure 5 : Pipeline to find missing data out of Emotional Intelligence measurement test 74

Figure 6 : Pipeline for Emotion detection using Images 75

Figure 7 : Labelled Faces in the wild 77

Figure 8 : Proposed method for calculating the rank of features 78

Figure 9 : Proposed framework for detecting emotions from images 78

Figure 10 : Results of forward feature selection: Accuracy v/s the number of features, Laugh vs Angry 86

Figure 11 : Results of forward feature selection: Specificity v/s the number of features, Laugh vs Angry 86

Figure 12 : Results of forward feature selection: Sensitivity v/s the number of features, Laugh vs Angry 86

Figure 13 : Classification of Images data 88

Figure 14 : Classification efficiency on the basis of individual features 91

Figure 15 : Classification efficiency 92

Figure 16 : Regression Using Neural Networks 93

Figure 17 : Feature Selection using Feature Discrimination Ratio 94

Figure 18 : Levenberg Marquardt training Algorithm with 10 neurons and epoch=3 97

Figure 19 : Levenberg Marquardt training Algorithm with 8 neurons and epoch=2 98

Figure 20 : Levenberg Marquardt training Algorithm with 6 neurons and epoch = 4 99

Figure 21 : Levenberg Marquardt training Algorithm with 5 neurons and epoch = 4 100

***Figure No. Page No.***

Figure 22 : Levenberg Marquardt training Algorithm with 3 neurons and epoch =5 101

Figure 23 : Bayesian Regularization training Algorithm with 10 neurons and epoch = 224 102

Figure 24 : Bayesian Regularisation training Algorithm with 8 neurons and epoch = 369 103

Figure 25 : Bayesian Regularisation training Algorithm with 6 neurons and epoch = 714 104

Figure 26 : Bayesian Regularisation training Algorithm with 5 neurons and epoch = 422 105

Figure 27 : Bayesian Regularization training Algorithm with 3 neurons and epoch = 357 106

Figure 28 : Conclusion 108

**LIST OF TABLES**

***Table No. Page No.***

Table 1 : Categories of emotional intelligence 1

Table 2 : Quantitative and qualitative classification 2

Table 3 : Qualitative market research techniques 3

Table 4 : Literature in areas of emotional intelligence 11

Table 5 : Formats of emotional intelligence 14

Table 6 : Areas and branches of emotional intelligence 44

Table 7 : Various tests of emotional intelligence 63

Table 8 : Terminology of machine learning 69

Table 9 : Variables 77

Table 10 : The results of forward feature selection: accuracy, specificity and selectivity 85

Table 11 : Fisher discrimination ratios of the features 89

Table 12 : Ranking of the features on the basis of the fisher discrimination ratio 90

Table 13 : Results of the 10-fold cross-validation 91

Table 14 : Performance enhancement by varying the training algorithm and the number of neurons: 97

**List of Abbreviations**

TMMS – Trait Meta-Mood Scale

EI – Emotional Intelligence

LMX – Leader-member exchange

GEI – Group Emotional Intelligence

WEIS – Wong Emotional Intelligence Scale

SSREIT – Schutte Self Report Emotional Intelligence Test

ECI – Emotional Competence Inventory

ESAP – Emotional Skills Assessment Process

EQ-I – Emotional Quotient Inventory

DHEIQ – Dulewicz & Higgs Emotional Intelligence Questionnaire

SVM – Support Vector Machine

FDR – Fisher Discriminate Ratio

WASI – Wechsler Abbreviated Scale of Intelligence

**Executive Summary**

Intelligence is what differentiates human from other living organisms on this planet. Intelligence has been defined in various ways at different times by different disciplines.

Intelligence is what makes us think and do things which others cannot. Intelligence evolved over the decades, although it has been that was around always, but the definition changed with time and types emerged. Emotional intelligence (EI) must have been in humans forever but was not being talked about so much until 25 years ago. It has gained much popularity in the last 25 years. After a few years of Emotional Intelligence, another kind of intelligence became popular, and that was customer intelligence. It is being gathered in many ways, and one of the very involved ways is to use qualitative market research techniques. A recent intelligence is about machines and is called Artificial Intelligence.

The purpose of this study is to assess the importance of emotional intelligence in qualitative market research techniques (customer Intelligence) and artificial intelligence is used to detect the emotions from the facial images. Another purpose is to automate the measurement of Emotional Intelligence by finding the essential features and missing data out of emotional intelligence measurement test.

In the pursuit to detect images from the face, feature extraction was done using Principal Component Analysis (PCA). This experiment aims to recognise emotions from a given set of pictures. The problem is a classification problem and comes under supervised learning. Since each image has many features, feature extraction techniques were required to reduce the feature set. This research applies PCA for transforming the dimensions of the data. PCA helps in converting the data and improves the efficiency and effectiveness of the classifier.

 If the number of features of the data is large, it takes more time for computation, and more memory is required to store and process the data. The understanding of the results is also hampered because of failure to visualise the data. As some of the features are not relevant, so feature selection was made using the Fisher Discriminant Ratio, and the classification was done using Support Vector Machine (SVM). The application of forward feature selection was used to reduce the number of features. The suggested model reads a set of images, converts them to a two-dimensional array, followed by the application of PCA. The resultant data is subjected to forward feature selection. This resulted in reducing the dimensionality of the data to a large extent. High values of accuracy, specificity and sensitivity conclude that the proposed machine learning model can help to identify emotions. The accuracy, specificity and sensitivity are encouraging. The average accuracy is 0.80; specificity is .97 and sensitivity is 0.75. This helps to conclude that this model can detect emotions on facial images by 80% accuracy and will be specific 97% times and sensitive 75% times.

This study helps in the measurement of EI by finding the most important features of the TMMS test of EI using Machine Learning techniques. It is intended to carry out similar experiments in the future for the remaining tests used for measuring EI, and hence to develop a better model for understanding, classifying and predicting EI. In order to measure EI, issues like the handling of noise and regression need to be addressed. This study suggests a framework to do the same. Regression analysis is used to find the relation between the dependent and the independent variables. Neural Network has been used to carry out the regression to find missing data of emotional intelligence measurement test.

The study created a framework to classify the faces based on emotions. It was concluded that artificial intelligence could help in increased emotional intelligence and gather customer intelligence. In a nutshell, it can be said that Emotional Intelligence plays a role in qualitative market research techniques, as reported. So there are a significant relationship in Emotional Intelligence and qualitative market research techniques. It is also concluded that missing data while measuring EI can be predicted using regression techniques. It is also concluded that features of the existing EI test can be ranked according to their importance to get the most important features. The emotions on faces can be detected using machine learning, and that can help in study consumer behaviour as behaviour comprises of emotions, thus increasing the impact of qualitative market research techniques.

The first chapter of the thesis gives an introduction and classification of emotional intelligence and qualitative market research. The chapter also charts out the scope of the study, parts of the study under its orientation and most importantly, the significance of the study. The second chapter discusses the literature published in this area with details of 21 tests of emotional intelligence. It is followed by the third chapter, which discusses the research objectives, hypothesis and the conceptual framework of the study. The fourth chapter gives details of the survey, including sampling, sample size & variables and pre-processing of data. The fifth chapter explains the experiment, observation and analysis of data. Conclusion and contribution are given in the Sixth chapter, and recommendations are made in the Seventh chapter. Some implications are explained in chapter 8th and limitation, and future scope of the study is given in the last (Ninth) chapter.

# CHAPTER 1

# INTRODUCTION

**Figure 1: Research Workflow**

## 1.1 Defining and Classifying Emotional Intelligence

It is essential to understand one's feelings and that of others. This ability is referred to as Emotional Intelligence (EI) (Goleman D, 1998).

EI can be classified into two categories the ability mode and the trait mode.

**Table 1: Categories of EI**

|  |  |
| --- | --- |
| **Type**  | **Description** |
| Ability Mode | The Ability EI refers to a person's ability to perceive, use, understand and regulate emotions in oneself and others |
| Trait Mode | Relates to a person's self-perception of his emotional ability |

Self-report Trait Meta-Mood Scale (TMMS) can be used to measure perceived EI. The scale measures the ability of an individual to recognise emotions, to distinguish between them and finally to regulate them. It is important to identify one's feelings and to disambiguate the feelings as well. Finally, a person with a good EI may be able to change the negative emotions and maintain a positive outlook.

## 1.2 Market Research

### 1.2.1 Definition

According to American Marketing Academy, "Marketing research is the function that links the consumer, customer, and public to the marketer through information–information used to identify and define marketing opportunities and problems; generate, refine, and evaluate marketing actions; monitor marketing performance; and improve understanding of marketing as a process. Marketing research specifies the information required to address these issues, designs the method for collecting information, manages and implements the data collection process, analyses the results, and communicates the findings and their implications" (Marketing, R., & Giesler, M. 2010).

### 1.2.2 Classification

**Table 2: Quantitative and Qualitative Classification**

|  |  |
| --- | --- |
| **Quantitative market research** | **Qualitative market research** |
| Measurable(goal is to measure) | Observable (goal is to discover) |
| How Much | What, Why |
| Structured data collection method | Semi-structured data collection methods |
| Numbers and Statistics | Description |

##

## 1.3 Qualitative Market Research Techniques

Qualitative market research is a set of research techniques in which data is obtained from a relatively small group of respondents. Qualitative researchers working in market research companies want to get an in-depth understanding of [consumer behaviour](http://en.wikipedia.org/wiki/Human_behavior) to study the how and why of the [decision](http://en.wikipedia.org/wiki/Decision_making) [making](http://en.wikipedia.org/wiki/Decision_making) in addition to when and what. However, the most striking advantage of qualitative research is that one may reach previously unexplored findings. It involves the collection of data from a relatively smaller number of respondents by asking questions and observing behaviour. In qualitative market research, questions are open-ended in nature.

**Table 3: Qualitative Market Research Techniques**

|  |  |
| --- | --- |
| **Technique** | **Description** |
| **Focus group** | A guided conversation in which a researcher (or research team) meets a collection of similarly situated individuals to uncover information about a topic |
| **Ethnography** | The researcher studies a whole cultural group in a natural setting over a specific period. The study is carried out by living with the subjects within their natural environment like any other ordinary person |
| **In-depth interview** | It is a long and confidential one on one conversation in an interview format with the help of open-ended questions. It is usually conducted around the natural surroundings of the participant to make him or her comfortable. |

###

### 1.3.1 Focus group

Focus group, a qualitative market research technique, is a guided conversation in which a researcher (or research team) meets a collection of similarly situated individuals to uncover information about a topic. The advantage of a focus group over a series of individual interviews is that statements from one participant encourage other participants to share their comments and to have their experiences and interpretations of events and actions questioned. It can lead to stimulation of memories and also to unconventional clarifications. The focus group results in data that may generally be generated in a series of individual interviews but also obtain information from the participants by interacting among themselves, building on and replying to the comments of one another (and thereby pushing them to greater clarity and thoroughness). (Schutt, 1999)

### 1.3.2 Ethnography

Ethnography is a qualitative market research technique, in which the researcher studies a whole cultural group in a natural setting over a specific period. A cultural group can be any group of individuals who share a collective social experience, location and other social characteristics of interest. Most of the time, the study is carried out by living with the subjects within their natural environment like any other ordinary person. Hence it involves a lot of fieldwork and personal touch. Deep interaction with people plays a crucial role in gaining insights about society and its culture.

### 1.3.3 In-depth interview

An in-depth interview is a qualitative market research technique which involves a deep and confidential one on one conversation. The interview takes place as per guiding rules prescribed by the client. It is usually conducted around the natural surroundings of the participant to make him or her comfortable and open to a series of deep question and answer round. The duration of an in-depth interview varies between one to two hours. Full activity is audio or video recorded for further analysis. However, complete assurance is given to the participants that the questions are crucial to the survey and that their conversation will remain confidential.

**1.4 Background Information**

The technology has changed the world in the past 20 years. More and more technological advancements are adapted in every field for higher profits and better returns. Businesses are increasingly using machine learning algorithms to increase performance and productivity. Qualitative market research is also not exempted from these technological changes. Information technology has created opportunities to gather data through smart ways for market research analysts.

Emotional Intelligence (EI) is preferred to take responses from different respondents across the globe, in a smart way. EI is a person's ability to recognise, assess effectively, control, and express emotions effectively. EI is accepted as productive for personal and professional attainment.

Further, Emotional Artificial Intelligence tries to categorise and respond to human emotions by reading facial expressions, analysing voice levels, scanning eye activities. Emotional AI techniques are already being used in several businesses, ranging from gaming to market research, advertising, and insurance sector.

As per the Gartner trend insight report published in 2017", "by the year 2022, 10% of all smart PDA (personal digital assistance) devices will contain some emotion recognition system". Furthermore, one of the top global leaders, Amazon, inventor of Alexa as a digital assistant for home usage, has filed copyright and patents for emotion-detecting technology that identify person's emotion that how a person is feeling, these emotions could be happy, sad, angry, distress or terrible. After getting the mood of a person, Alexa selects the right music to play or to personalise a shopping offer.

Affectiva, an Emotional AI start-up has developed an in-vehicle emotion recognition system, with the help of microphones and cameras, to sense whether a driver is sleepy, distracted or annoyed and can respond by decreasing the temperature or pulling the seatbelt.

More data can be transmitted with the help of facial expressions as compared to what we say, and many intelligent models are developed to decode accurate information out of facial or emotional expressions. Machine learning algorithms are helping Emotional Intelligence more effective for many businesses.

**1.5 Scope of the Study**

The scope of the study is to evaluate the significance of emotional intelligence in qualitative market research. Emotional intelligence helps to detect the mood of a person by analysing expressions. This study helps in the measurement of EI by finding the most important features of the TMMS test of EI using Machine Learning techniques. However, the proposed method is also valid for the other tests of measurement of EI.

In this study, Principal Component Analysis (PCA) is used for feature extraction to detect images from the face. Additionally, regression analysis is used to find the relation between the dependent and the independent variables. Whereas, a neural network has been used to carry out the regression to find missing data of EI measurement test.

One of the objectives of this study is to identify emotions from a pool of pictures. This comes under the category of classification solved with the help of supervised machine learning models. Every image has countless features. This feature set is reduced with the help of feature extraction techniques like PCA. It helps in conversion of data and improves the usefulness of the classifier.

**1.6 Orientation of the Study**

The research orientation of this study is such that it is divided into two halves. In the first part of the research, the importance of emotional intelligence in qualitative market research techniques is assessed based on the literature review. Many researchers propose several tests overtime for the assessment of emotional intelligence. However, the Trait Meta-Mood Scale (TMMS) is used for the assessment of emotional intelligence (EI).

The second part of the study comprises to automate the measurement of emotional intelligence.

Conceptual frameworks are proposed to find the essential feature out of Emotional Intelligence measurement test using feature selection, to find missing data out of Emotional Intelligence measurement test using regression, to detect the emotions from the images by face detection.

In the pursuit to detect images from the face, Principal Component Analysis is used for feature extraction. As not all, the features are relevant, so Feature Discrimination Ratios is used for feature selection, whereas Support Vector Machine is used for classification.

Regression analysis is used to find the relationships between variables, and Neural Network is used to carry out the regression to find missing data of emotional intelligence measurement test.

**1.7 Significance of the Study**

The study is highly important from the application point of view as very limited research has been conducted in this area. This study gives a new dimension to the measurement of EI by finding the most important features of the TMMS test of EI using Machine Learning techniques. This study significantly helps companies recruiting especially IT companies in measuring EI of their existing and prospective employees as this study solve the problems encountered during measurement. Big IT organisations like Infosys recruit thousands of candidates in India for the entry-level position from a pool of around half a million applicants every year. These tests are conducted in colleges and universities with limited computing resources for a large number of candidates. The data gathered for testing EI will be huge, and it becomes tough to include a test to measure EI in the recruitment process. The proposed framework helps to reduce the need for computing resources.

This study contributes to qualitative market research techniques. The study suggests the relevance of facial expressions in taking feedback from the customer.

This study also helps various businesses who need to take customers' experience and feedback with the help of facial expressions. EI has a significantly positive impact in vital aspects such as sensitivity for own and other's emotions, managing stress, holding positive mood, etc.

**1.8 Chapter Outline**

Chapter 1: Introduction – the chapter gives a brief account of the various terms and concepts to be studied in-depth to find out the probable solutions for the associated research problems. It gives an introduction and classification of emotional intelligence and qualitative market research. The chapter also charts out the scope of the study, parts of the study under its orientation and most importantly, the significance of the study.

Chapter 2: Literature Review – the chapter discusses in detail the concepts of the study, which includes emotional intelligence and 21 tests of measurement of emotional intelligence; and machine learning. Previous studies on the concepts mentioned above have been cited extensively in the chapter to draw adequate literature support.

Chapter 3: Research Objectives & Hypothesis– the chapter discusses the research objectives of the study, which is like the north star of the study. The chapter also summarises the conceptual framework of the study. It also explains the hypothesis of the study.

Chapter 4: Research Methodology–This chapter gives details of the survey, including sampling, sample size & variables. It also throws some light on data collection and the methods used for pre-processing of data. It explains the use of a support vector machine for classifying images based on emotions and of neural networks for regression to find missing data.

Chapter 5: Experiment, Observation and Analysis of data- This chapter explains experimental results on the detection of emotions from the facial images and use of images data to establish that emotional intelligence plays a role in qualitative market research techniques. It details the experiment and observation for feature selection and regression of text data to find the essential features of the TMMS test of Emotional Intelligence measurement. It also shares the application of neural network for regression.

Chapter 6: Conclusion & Contribution – the chapter summarises the results achieved to draw meaningful conclusions that could have certain implications for society. The chapter also acknowledges the contribution done by the study in the body of knowledge and the current research in the industry.

Chapter 7: In this chapter, the recommended strategies have been discussed.

Chapter 8: In this chapter, the implications of the study have been explained.

Chapter 9: In this chapter, limitation and future scope of the study have been highlighted.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Literature in areas of Emotional Intelligence

**Table 4: Literature in areas of EI**

| **S.No** | **Author(s)** | **Research Findings** |
| --- | --- | --- |
| **1.** | Ding Xiaqi, Tian Kun, Yang Chongsen, Gong Sufang (2012) | This study explores how leaders' emotional intelligence (EI) impacts juniors' trust and examines the roles played in the process by a discouraging leadership and a supportive leadership mentioned as Leader Members Exchange (LMX). |
| **2.** | Cheok San Lam, Eleanor R.E. O'Higgins(2012)  | The purpose is to discover the possible mediating effects of managers' transformational leadership style on the relationships between managers' emotional intelligence and employees' performance, job satisfaction, organisational commitment, and anxiety.The results showed that managers' transformational leadership style completely reconciles the connection amid managers' emotional intelligence and employee job satisfaction.  |
| **3.** | Gabriele Bartsch (2012) | This study uses the program Blickwechsel ("Perspective Change") and describes the relationship between societal engagements with internal managerial development. The study also proves that one can be motivated for a leadership role with the combination of practice and counselling. |
| **4.** | Geoff Ryan, Lyle M. Spencer, Urs Bernhard (2012) | The study reports data empirically, linking competencies of individual leaders to business profitability and demonstrates that competencies are cross-culturally valid. This study found a correlation in profit growth and boss rating of subordinate employees' competencies in European Union and North America which added cross-cultural validity |
| **5.** | Gilles E. Gignac, Richard J. Harmer, Sue Jennings, Benjamin R. Palmer (2012) | This study examines how enhancing Emotional Intelligence (EI) in salespeople increases sales performance. The results showed that "rater-report EI is correlated significantly with sales performance. The EI training group demonstrated increases in both self-report and rater-report EI. Finally, the group of salespeople who received the EI training program outperformed a corresponding control group. It was found that EI may not only act to enhance sales performance, but it may also act as a shield to stressful situations." |
| **6.** | Hakan Er kutlu, Jamel Chafra (2012) | This study used a sample of 910 nurses working in 12 Turkish hospitals and established that proactivity is positively associated with team empowerment.  |
| **7.** | Mohammad Suleiman Awwad, Hanane Kada Ali (2012) | The paper studies the effect of managers' emotional intelligence, employees' creativity and organisational climate on entrepreneurial orientation. The research established that these three factors have a constructive influence on entrepreneurial spirit. |
| **9.** | Richard E. Boyatzis, Ceferi Soler (2012)  | The study shows how two fifth-generation family business members inspired others by building resonant relationships with them and applying emotional and social intelligence.  |
| **10.** | Robert J. Emmerling, Richard E. Boyatzis, (2012) | This study confirmed that emotional and social competence is an essential concept in management development in most of the organisations.  |
| **12.** | Timo Vuori, Jouni Virta Harju (2012) | The focus of the study is to establish that emotional arousal can be amplified in ways that are loosely united with the rational dimension of sense giving. |
| **13.** | Christos Nicolaidis, Kleanthis Katsaros (2011) | The study investigates "the influence of emotional attitudes towards change on managers' tolerance of ambiguity and finds that three factors characterize managers' emotional attitudes towards change, namely dominance, arousal, and pleasure.**"** |
| **14.** | Hongguo Wei, Shaobing Li (2011) | The findings of this study indicate that the holistic man model based on emotions contains natural, social, moral, and transcendental dimensions. Self-cultivation is significant for management practices and education. |
| **16.** | Mina Beigi, Melika Shirmohammadi (2011) | The study investigates the effects of an EI training program on the EI of service providers and the quality of service provided by them.  |
| **17.** | Peter J. Jordan, Ashlea Troth (2011) | The paper examines the mediating effect of leader-member exchange (LMX) on the relationship between followers' emotional intelligence and the outcomes of turnover intention and job satisfaction. The results show that the quality of LMX mediates the relationship between follower emotional intelligence and both turnover intention and job satisfaction. |
| **18.** | Peter Love, David Edwards, Elliot Wood (2011) | This paper studies how EI of a construction manager can relate to the success of construction projects.  |
| **19.** | Rachel Gabel-Shemueli, Simon Dolan (2011) | The purpose of this paper is to propose EI competencies as an indicator for overall cross-cultural adjustment of managers and professionals in its three dimensions: work, interaction and non-work adjustment.  |
| **20.** | Umar Ghuman (2011) | The basic purpose of this research is to understand Group Emotional Intelligence (GEI) and to formulate the means for the empirical measurement of GEI. It was found that GEI is a multifaceted concept and is better understood in the presence of both norm approach and system conceptualisation. Norm approach means that all the individuals are free to share their emotions in the group, whereas system conceptualisation means that the group understands its relation with a larger organisation. |
| **21.** | Ying Hong, Victor M. Catano, Hui Liao (2011) | This paper studies emotional intelligence (EI), motivation to lead (MTL) and leadership emergence. The results suggest that participants high in affective-identity MTL became leaders in leaderless discussions, while high social-normative MTL individuals assumed leadership roles in long-term project teams." |

## 2.2 Tests for measurement of EI

An extensive literature review is carried out to find the tests in EI and their importance. This thesis uses one of the tests, namely the Trait Meta-Mood Scale (TMMS), which is commonly used emotional intelligence (EI) assessment. However, the proposed method is also valid for the other tests of measurement of EI.

### 2.2.1 Mayer-Salovey-Caruso Emotional Intelligence Test

#### 2.2.1.1 Introduction

John Mayer developed the "Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT)", Peter Salovey, and David Caruso in 2002 as advancement over their previous measure of EI, the "Multifactor Emotional Intelligence Scale (MEIS)" (Mayer, Caruso, & Salovey, 1999). The MSCEIT is based on the ability model of EI (Salovey & Mayer; 1990, 1997).

#### 2.2.1.2 Format

The MSCEIT is an ability test in contrast to most of the other tests in EI, which are self-assessment or 360-degree assessment tests. It consists of 141 items to be rated on a 5-point scale though the scale anchors vary across items. The items are grouped into 8 task levels, which are then grouped into 4 EI branches, which are further grouped into two primary areas of EI as given below.

**Table 5: Formats of Emotional Intelligence**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Domain** | **EI Areas** | **EI Branches** | **Task levels** | **Question Types** |
| EI | Experiential EI | Perceiving | Faces | Identify emotions in faces |
| Pictures | Identify emotions in landscapes & designs |
| Using | Facilitation | Knowledge of moods' impact on thinking |
| Sensations | Relate various sensations to emotions |
| Strategic EI | Understanding | Changes | MCQs about how emotions change over time |
| Blends | Emotion vocabulary definitions |
| Managing | Emotion Management | Indicate the effectiveness of solutions to internal problems |
| Emotional Relations | Indicate the effectiveness of solutions to others' problems |

The MSCEIT is available in three formats viz. online, software, pen, and paper.

#### 2.2.1.3 Scoring pattern

The objectivity of MSCEIT does not end with its format, and scoring is very objective. It is based on the concept of 'better and worse' answers rather than 'right and wrong' answers based on consensus as well as expert choice, thus giving rise to two different scores.

i) Consensus scoring based on the response of the majority of test-takers.

ii) Expert scoring based on the response of members of the International Society for Research on Emotions.

A total of 15 scores are calculated for each of the task levels, EI branches, EI areas mentioned before, along with a total EI score. Sometimes, a positive-negative bias score and a scatter score is also provided. The scores are displayed in either of the Personal Summary Report, Development Report, or Resource Report.

#### 2.2.1.4 Applications

**2.2.1.4.1 Possibilities**

The MSCEIT can be used

i) By individuals for self-assessment and development as very few tests provide such detailed scores as MSCEIT, which can aid an individual in identifying potential areas of improvement.

ii) In hiring, promotion, and other high stake decisions since the MSCEIT is an ability test and hence it free from self-estimation bias or socially desirable responding.

iii) To aid in career development and succession planning by evaluating the emotional and cognitive abilities of the respondent objectively.

iv) In coaching, mentoring, and leadership development programs.

v) In counselling and employee wellness programs.

vi) As a compulsory inclusion in any EI class or workshop to expose the students or participants to the various models and measures of EI since MSCEIT is unique in being an ability test and can provide a welcome diversion from the long-range of self-assessment tests of EI.

vii) As an ideal test for research purposes since it is independent of personality variables and behavioural preferences.

Thus MSCEIT provides some clear advantages over the other EI measures and can be used in many cases where the other tests fail.

**2.2.1.4.2 Limitations**

Despite the widespread use of MSCEIT, it is recommended that its application be avoided

i) In non-western cultures since MSCEIT is based on North American data and unlike certain other tests like Wong's Emotional Intelligence Scale (WEIS), it is not measurement invariant across cultures, and cultural variation can lower scores on the MSCEIT. (Mayer, Salovey & Caruso; 2002)

ii) As a sole tool for performance appraisal as unlike tests like EQ-i or TEIQue, it has no scope for 360-degree appraisal.

### 2.2.2 Trait Meta-Mood Scale

#### 2.2.2.1 Introduction

The Trait Meta-Mood Scale (TMMS) was developed in 1995 by Salovey et al. It was the first formal measure of EI based on the ability model of emotional intelligence (Salovey & Mayer, 1990). This scale was a development over the previously used State Meta-Mood Scale (SMMS) of Mayer and Gaschke (1988), which focused on the ongoing moods of an individual rather than his ability to understand and manage it.

#### 2.2.2.2 Format

The TMMS consists of 30 items to be rated on a scale of 1 to 5, where selecting 1 means that the respondent has strong disagreement and selecting 5 means the respondent has a strong agreement in his viewpoint.

#### 2.2.2.3 Scoring pattern

The TMMS measures three factors of emotional intelligence, namely,

i) Attention to feelings/Attention to emotion, which consists of 13 items like "I believe in acting from the heart."

 ii) The clarity in discrimination of feelings/Emotional clarity or which consists of 11 items like "I am rarely confused about how I feel."

 iii) Mood repair/Emotion repair, which consists of 6 items like "When I become upset, I remind myself of all the pleasures in life."

A total of 15 items are reversed scored, and then the scores are summed up according to the classification as mentioned above to get the final score in each of the three EI constructs.

#### 2.2.2.4 Criticism

Various criticisms have been levied against TMMS. Firstly, despite being originally based on the ability model of EI, it measures trait EI since it records the respondents' self-perception of their cognitive and emotional abilities rather than their actual abilities. Secondly, TMMS does not provide any global EI score and instead just gives separate scores on the three factors of EI. Thirdly, it does not cover all the facets of EI focusing only on the "self-emotions" part of EI while completely overlooking the "others' emotions" part and hence the inclusion of the term Meta-Mood in the name (from meta-mood experience).

#### 2.2.2.5 Applications

**2.2.2.5.1 Possibilities**

The TMMS can be used

i) In an introductory session on EI to expose a complete novice to the concept of EI and its measures.

ii) By individuals for personal assessment and development since they can focus on the factor on which they have scored less.

iii) To study the role of EI in psychosomatic disorders. (Goldman et al., 1995)

**2.2.2.5.2** **Limitations**

The use of TMMS should be avoided

i) in an organisational setting where interpersonal relations are equally and perhaps even more important than individual skills and abilities.

ii) in any situation where the respondent has an incentive to impress the facilitator as self-report measures are susceptible to faking.

iii) for research purposes as it offers a very rudimentary measure of EI and the other tests of EI that have been developed in the last decade or so seem to provide much more exciting opportunities to the researcher than TMMS.

#### 2.2.3 Wong and Law Emotional Intelligence Scale

#### 2.2.3.1 Introduction

The Wong and Law Emotional Intelligence Scale (WLEIS) was developed in 2002 by Chi-Sum Wong and Kenneth S. Law. It is based on the ability-based model of Davies et al. (1998), which is complementary to the original ability-based model of Mayer and Salovey (1990).

#### 2.2.3.2 Format

The WLEIS has 16 items that are rated on a scale of 1 to 7. If a respondent is selecting 1, it means he has a strong disagreement; on the other hand, choosing 7 depicts strong agreement. The WLEIS is made up of four sub-scales corresponding to each of the four dimensions of Davies et al. 's model, each consisting of four items. The four sub-scales are as under:

i) Self-Emotions Appraisal (SEA): It consists of items like "I understand what I feel."

ii) Others-Emotions Appraisal (OEA): It consists of items like "I am a good observer of others' emotions."

iii) Use of Emotion (UOE): It consists of items like "I am a self-motivating person."

iv) Regulation of Emotion (ROE): It consists of items like "I have good control of my own emotions."

#### 2.2.3.3 Scoring pattern

The scores for each of the four sub-scales are found out by summing up the respondent's ratings on the individual items which make up the sub-scale. Finally, the scores obtained on the sub-scales are summed up to give the overall EI score of the respondent.

#### 2.2.3.4 Applications

**2.2.3.4.1 Possibilities**

The WLEIS can be used

i) In a classroom setting to introduce the students to the concept of EI and its measuring techniques due to its simple nature.

ii) By individuals for self-assessment.

iii) In assessments when there is a time constraint since the 16 items WLEIS can be applied with ease and speed.

The application of WLEIS garners special significance in

i) Studies carried out in the field of management, leadership, and organisational behaviour.

ii) Studies carried out in a variety of cultures since, in stark contrast to other tests like MSCEIT, which are suitable for application only in an American setting, the WLEIS is measurement invariant across cultures.

**2.2.3.4.2 Limitations**

The use of WLEIS should be avoided

i) In hiring and performance appraisal since WLEIS, being a self-report measure, is susceptible to faking.

ii) When exhaustive research is to be carried out since the 16 items WLEIS may prove to be too rudimentary and inadequate in comparison to some of its counterparts.

The Wong Emotional Intelligence Scale (WEIS) developed by Wong et al. (2004) can be used instead of the WLEIS to overcome the above limitations.

#### 2.2.4 Wong's Emotional Intelligence Scale

#### 2.2.4.1 Introduction

The Wong's Emotional Intelligence Scale (WEIS) was developed in 2004 by Wong et al. It is based on the same ability-based model of Davies et al. (1998) as its predecessor, the Wong and Law Emotional Intelligence Scale (WLEIS). However, it has a completely different format, being a forced-choice measure.

#### 2.2.4.2 Format

The WEIS consists of 40 items divided into two parts of 20 items each.

The first part provides the respondent with various scenarios, each with two possible reactions, and asks them to choose the one option that they prefer.

The second part consists of 20 ability pairs, and the respondent is asked to choose one's ability from each pair which he feels is relatively stronger in him, e.g., mental arithmetic or control one's emotions

#### 2.2.4.3 Scoring pattern

Based on the choices of the respondent in each of the 40 items, his overall EI score is calculated with the help of the scoring key. In WEIS, unlike its predecessor WLEIS, the overall EI score is calculated instead of calculating scores in each of the four EI dimensions viz. Self-Emotions Appraisal(SEA), Others-Emotions Appraisal(OEA), Use of Emotion (UOE), and Regulation of Emotion (ROE).

#### 2.2.4.4 Applications

**2.2.4.4.1 Possibilities**

The WEIS can be applied

i) In an organisational setting to relate EI to job satisfaction, organisational commitment, turnover intention, turnover behaviour, and job performance.

ii) To oriental cultures in contrast to some other tests like MEIS and MSCEIT, which were developed strictly for western populations.

iii) In all instances like staffing and performance appraisal where a self-report measure cannot be applied due to the possibility of faking as research has shown that the faking effect is considerably less in case of the forced-choice WEIS (Wong et al., 2007).

iv) To measure the EI outcomes for jobs that require various levels of emotional labour.

v) To study relationship outcomes in dyads and teams in addition to individual outcomes.

**2.2.4.4.2 Limitations**

The application of WEIS should be avoided

i) In high-stress jobs like those of health care professionals (Shih & Hsu, 2010).

ii) In a classroom setting for students with no previous exposure to EI as WEIS is more complicated than the corresponding self-report measures of EI like Schutte Self Report Inventory.

iii) When there is a time constraint, and WLEIS may be used instead.

#### 2.2.5 Tapia Emotional Intelligence Inventory

#### 2.2.5.1 Introduction

The Tapia Emotional Intelligence Inventory (TEIT) was developed in 2001 by Martha Tapia. It is based on Mayer and Salovey's ability-based model of emotional intelligence.

#### 2.2.5.2 Format

The TEIT has 41 items where the response is collected on a self-report basis. The responses mean the following: 1=never like me, 2=occasionally like me, 3=sometimes like me, 4=frequently like me and 5=always like me. The TEIT consists of four sub-scales, as given below.

i) Empathy which consists of 12 items of the inventory.

 e.g., I go out of my way to help someone in need.

 ii) Utilisation of feelings which consists of 11 items.

 e.g., I keep myself focused on my goals

iii) Handling relationships which consist of 9 items.

 e.g., I think about why I do not like a person.

iv) Self-control which consists of just 9 items.

 e.g. Traffic jams cause me to lose control.

#### 2.2.5.3 Scoring pattern

The scores for each of the four sub-scales are found out by summing up the respondent's ratings on the individual items which make up the sub-scale. Finally, the scores obtained on the sub-scales are summed up to give the overall EI score of the respondent.

#### 2.2.5.4 Criticism

Various criticisms have been levied against TEIT. Firstly, it has been declared a confused amalgamation of the ability and trait models since although it is based on Mayer & Salovey's ability model. It is a self-report test that depends on the respondent's self-perception rather than his cognitive and emotional ability (Perez et al., 2005). Secondly, the items and sub-factors measured of TEIT have been the bone of contention for long and different number of items and different sub-factors have been put forth from time to time.

#### 2.2.5.5 Applications

**2.2.5.5.1 Possibilities**

The TEIT can be used

i) In a classroom setting to introduce the students to emotional intelligence and its measuring techniques.

ii) By individuals for personal assessment.

iii) In place of the Schutte Self Report Inventory since there is a correlation between the subscales and total scores of both the scales.

v) Within organisations as a diagnostic tool to assess various shortcomings on the line of high turnover, poor individual and team performance, lack of job satisfaction, absence of organisational citizenship behaviour.

vi) In training programs since the knowledge of sub-scale scores will enable the respondents to focus on a particular aspect of EI they wish to improve.

**2.2.5.5.2 Limitations**

The use of TEIT should be avoided

i) In hiring, performance appraisal or any other situation where the respondent has an incentive to inflate his score as self-report measures are susceptible to faking.

ii) In different cultural settings since unlike the WLEIS (Wong & Law, 2002) or WEIS (Wong et al., 2004), no evidence has been found on the measurement invariance of TEIT across cultures.

### 2.2.6 Schutte Self Report Emotional Intelligence Test

### 2.2.6.1 Introduction

The "Schutte Self Report Emotional Intelligence Test (SSREIT)" was developed in 1998 by Australian based psychologist Nicola Schutte and others. It has come to be known by various names which include among others Schutte Self Report Inventory and Assessing Emotions Scale. It is based on Mayer and Salovey's ability-based model of emotional intelligence.

### 2.2.6.2 Format

The SSREIT consists of 33 items to be rated on a scale of 1 to 5, where selecting 1 means that the respondent has "strong disagreement" and selecting 5 means the respondent has "strong agreement" in his viewpoint. The statements are very generic like "I expect good things to happen", "I arrange events others enjoy" and so on. The respondents were asked to rate each item based on how they generally feel and are assured that the notion of right and wrong answer does not exist in order to garner an honest response.

### 2.2.6.3 Scoring pattern

The SSREIT measures four sub-factors of emotional intelligence (Ciarrochi et al. 2001), namely:

i) Emotional perception which consists of 10 items of the inventory focusing on the ability to comprehend the emotions of self and others.

 ii) Managing self-relevant emotions which consists of 9 items, deals with the ability to control one's own emotions.

 iii) Managing others' emotions which consists of 8 items, focuses on how the participant responds to and handles the emotions of others.

iv) Emotional utilisation which consists of just 6 items, is based on the respondent's ability to utilise emotions to positive ends.

Scores of three items viz. 5, 28 and 33 are reversed, and then the scores are added, according to the classification mentioned above to get the final score in each of the four constructs. The scores of the sub-factors can then be added on to give the overall emotional intelligence of the respondent.

### 2.2.6.4 Criticism

Various criticisms have been levied against SSREIT. Firstly, the emotional utilisation sub-factor has been found to exhibit poor reliability in both adults and adolescents. Secondly, the sub-factors measured by SSREIT have been the bone of contention for long, and different researchers have found different sub-factors using different factor analysis methods. Thirdly, SSREIT has been accused of suffering from criterion contamination. Finally, it fairs poorly in terms of both convergent and divergent validity.

### 2.2.6.5 Applications

**2.2.6.5.1 Possibilities**

The SSREIT can be used

1. In a classroom setting to introduce the students to emotional intelligence and its measuring techniques.

ii) By individuals for personal assessment.

iii) For counselling.

iv) In surveys to relate emotional intelligence to other factors like resilience, wellbeing etc.

v) Within organisations to assess the cause of high turnover, poor team performance etc.

Out of the above, SSREIT must be applied without fail in at least the first two situations.

**2.2.6.5.2 Limitations**

The use of SSREIT should be avoided

i) In recruitment and selection as self-report measures are susceptible to faking.

ii) In succession planning due to self-estimation bias.

In a gist, SSREIT can be applied only when complete honesty is expected from the respondent or the stakes are not that high.

### 2.2.7 Emotional Competence Inventory 2.0

#### 2.2.7.1 Introduction

Boyatzis, Goleman developed the Emotional Competence Inventory (ECI), and Rhee in 1999 based on Daniel Goleman's mixed model of emotional intelligence as published in his book "Working with Emotional Intelligence" in 1998. A revised version of ECI was developed in 2002 which came to be known as ECI 2.0.

#### 2.2.7.2 Format

The ECI 2.0 is a 360-degree assessment tool but can also be used only for self-assessment though with lesser reliability. There is also a university version of ECI 2.0 available known as ECI-U.

The ECI 2.0 consists of 72 items which are rated on a 6-point Likert scale (1 = Never, 5 = Consistently, 6 = Do not Know) and measures 18 EI competencies which can be grouped under 4 EI constructs or competency clusters.

#### 2.2.7.3 Scoring pattern

The ECI 2.0 can be scored in two ways viz. average-item scoring, which is self-explanatory and Hay Group scoring based on the following algorithm.

The self-awareness competencies are compulsory. In the self-management cluster, only emotional self-control is mandatory, one out of transparency and adaptability is mandatory, and one out of the remaining three competencies is mandatory. In the social awareness cluster, empathy and one out of the remaining two competencies are mandatory.

Based on the above algorithm, weighted average scores are calculated, which represent the competency level of the participant.

#### 2.2.7.4 Applications

The ECI 2.0 can be used

i) To relate EI with a wide array of outcomes such as an individual's life success, department performance, perceptions of leadership in a group, sales performance, firefighter performance, softball coaches win/loss record, and parishioner satisfaction. (Steven B. Wolff, 2005)

ii) In organisations as an HRD tool and used for developmental purposes by identifying the strong and weak areas of the participant and then taking appropriate measures.

iii) for the development of leadership competency models in organisations. (Gowing et al., 2001)

The ECI-U too can be used as a developmental tool but in a university setting only and used to

i) Relate EI to student wellbeing and performance.

ii) Assist in setting career goals and provide training when required.

The use of ECI 2.0 should be avoided

i) For administrative purposes, especially in high stakes decisions like determining compensation, promotion, hiring etc. due to two reasons. Firstly, ECI 2.0 is not an ability test, unlike say, MSCEIT. Secondly, the competencies measured by ECI 2.0 are generic and are not job-specific.

ii) In research as much of the information available about ECI 2.0 is based mostly on the technical manuals periodically published by the Hay Group, which may be suitable for human resource management. However, unless sufficient data is available regarding the psychometric properties of ECI 2.0, researchers should look elsewhere for EI measurement tools.

#### 2.2.8 Emotional Skills Assessment Process

#### 2.2.8.1 Introduction

The Emotional Skills Assessment Process (ESAP) was developed by Darwin B. Nelson and Gary R. Low based on their transformative model of EI and was published in their book "Emotional Intelligence: Achieving Academic and Career Excellence in College and Life" (Nelson & Low, 2011)

#### 2.2.8.2 Format

ESAP is available in the forms: ESAP, ESAP-A/ESAP-B, and ESAP-C. The original ESAP is popularly known as the ESAP Education Version. While the ESAP Education Version (to be called ESAP henceforth) consists of 213 items, ESAP-A/ESAP-B are two shorter parallel versions of ESAP made up of 87 items each. Finally, ESAP-C is the corporate version which consists of only 77 items. All the four versions of ESAP share the same underlying structure and measure the same set of EI skills, and hence only ESAP is discussed here.

The 213 items of ESAP measure 10 emotional intelligence skills and 3 problem areas which can be further grouped under 4 EI dimensions. The 3 problem areas are to be converted into 3 corresponding skills.

i) Interpersonal Communication under Stress consists of Assertion (18 items), Aggression (18 items), Deference (18 items).

ii) Self-Management in Life and Career consists of Drive Strength (25 items), Time Management (12 items), Commitment Ethic (12 items), Change Orientation (12 items).

iii) Personal leadership consists of Comfort (12 items), empathy (12 items), Decision Making (12 items), Leadership/ Positive Influence (12 items).

iv) Intrapersonal Development consists of Stress Management (25 items), Self-Esteem (25 items).

#### 2.2.8.3 Scoring pattern

Unlike the other EI scales, ESAP does not provide any overall EI score and rather provides scores on the 13 EI skills mentioned before. The scores in each of the skills are plotted on the Emotional Skills Profile Map for identifying the skills to develop, strengthen and enhance. Similarly, the scores in each of the problem areas are also plotted on the map for identifying the low, normal and high range.

#### 2.2.8.4 Applications

**2.2.8.4.1 Possibilities**

ESAP was developed primarily for use in education and training and hence all its applications are in that line only. It can be used

i) To introduce students to the concepts of EI and its importance in various aspects of life.

ii) For deciding on a career path for the students based on their skills and mentoring where required.

iii) In counselling to identify the problem areas and take corrective actions.

ESAP-A and ESAP-B are two parallel scales to be used

i) In research for pre-test and post-test study.

ii) To measure program effectiveness by analysing learning from the program.

iii) Instead of ESAP when there is a time constraint.

ESAP-C has similar applications as ESAP but in a corporate setting. It can be used

i) In training and development by identifying the skills to be developed and then initiate coaching and mentoring.

ii) In counselling and employee wellness programs.

iii) In career development and succession planning.

iv) To promote a learning environment in the organisation.

**2.2.8.4.2 Limitations**

The use of ESAP is not recommended

i) In recruitment and selection as ESAP is a self-assessment test and is susceptible to faking.

ii) In any study of EI or any survey carried out to relate EI to other variables neither does ESAP provide any global EI score nor is there any sufficient research available on the test.

#### 2.2.9 Emotional Quotient Inventory

#### 2.2.9.1 Introduction

The "Emotional Quotient Inventory (EQ-i)" is based on the personal capabilities approach to EI(Bar-On, 1997). It has proved to be one of the most effective measures of EI and has undergone many revisions down the years, and the EQ-i discussed here was introduced later(Bar-On, 2004).

#### 2.2.9.2 Format

The EQ-i is available in the following forms: EQ-i, EQ-i: Short, EQ-i: Short Post-Secondary and EQ-360. The EQ-i and EQ-360 consist of 133 items each, whereas the two shorter versions consist of 51 items. All the four scales share the same underlying theory and structure, and hence the EQ-i is discussed here.

The EQ-i consists of 133 items in the line of "I responded openly and honestly to the above sentences" to be rated on a scale of 1 to 5 where 1 = "Very seldom or not true of me" and 5= "Very often true of me".

The EQ-i is available in three formats viz. online, software, pen and paper.

#### 2.2.9.3 Scoring pattern

The 133 items of the EQ-i can be used to calculate three types of scores viz. Total EQ-score, five Composite Scale scores and 15 Content Scale scores. The Total EQ-score is found from the five composite scales.

#### 2.2.9.4 Reports and Manuals

The individual reports that can be generated are Individual Summary Report, Development Report, Resource Report, Business Report, Leadership Report, and Higher Education Report.

The group reports that can be generated are Group Summary Report, Individual Across Administrations Report, Individual to Group Report, Group to Group Report, Group Across Administrations Report.

Additionally, a Multi-rater Feedback Report is generated for EQ-360.

Four manuals are available for the EQ-i viz. Technical Manual, User's Manual, Administrator's Guide, Facilitator's Guide

#### 2.2.9.5 Applications

**2.2.9.5.1 Possibilities**

The EQ-i can be used

i) By individuals for self-assessment and development by identifying and working on the EI constructs where improvement is possible taking the help of the "Individual Summary Report" and "Development Report".

ii) For leadership development in organisations using the "Leadership Report."

iii) In organisations for 360-degree appraisal using the EQ-360 form and the "Multi-rater Feedback Report" generated from it.

iv) To ensure a smooth transition from school to college life using the EQ-i: S PS form.

v) For studies across cultures where tests like MSCEIT which have been developed in a western setting cannot be used.

vi) In an organisational setting for career development, organisational development, executive coaching, team building and succession planning.

Thus most of the applications of TEIQue are pretty unique, and hence it is increasingly preferred over the other available EI measures.

**2.2.9.5.2 Limitations**

Despite the widespread use of EQ-i, it is recommended that its application be avoided

i) In hiring and other high stake assessments since EQ-i is, after all, a self-report measure and is susceptible to socially desirable responding (Grubb and McDaniel, 2008).

ii) In any in-depth study of EI since EQ-i includes some facets having no connection with emotions or intelligence while missing out on important facets of EI like expression, perception and regulation of emotion (Petrides, 2008).

#### 2.2.9.6 Recent development

MHS released an updated version of the EQ-i called EQ-i 2.0 on December 17, 2012, to remove the limitations of EQ-i but it remains to be seen how successful it is towards that end.

#### 2.2.10 Dulewicz & Higgs Emotional Intelligence Questionnaire

#### 2.2.10.1 Introduction

The Dulewicz & Higgs Emotional Intelligence Questionnaire (DHEIQ) was developed in 1999. It was based on the personal capabilities model of EI (Higgs & Dulewicz, 1999) contrary to the popular notion that it was based on the competency model of EI (Goleman, 1998).

#### 2.2.10.2 Format

The DHEIQ consists of 69 items to be rated on a scale of 1 to 5, where selecting 1 means that the respondent meant "not at all" and selecting 5 means respondent meant "to a very great extent". The items are generic like "I do not lose control when I am angry", "I make decisions quickly when necessary" and so on, but the authors never formally published the items comprising DHEIQ and rather focused only on the seven constructs of EI (Dulewicz & Higgs, 2000) in all their papers.

#### 2.2.10.3 Scoring pattern

The scores for each of the seven factors can be found out from the items comprising them, and ultimately, the global EI score can be calculated from the factor scores. As mentioned earlier, the authors have never published the items or their grouping into the seven EI dimensions and hence nothing more about the scoring pattern can be said at this point.

#### 2.2.10.4 Criticism

Various criticisms have been levied against DHEIQ. Firstly, DHEIQ has been criticised as being more of a personality measure than a measure of EI since many of the EI dimensions DHEIQ is based on has nothing to do with emotions. Secondly, there has been a lack of transparency from the authors, and the lack of adequate published research makes it tough to predict the reliability or validity of DHEIQ. Finally, DHEIQ seems to be a mash-up of the personality-based approach of Bar-On and the competency-based approach of Goleman.

#### 2.2.10.5 Applications

**2.2.10.5.1 Possibilities**

The DHEIQ can be used

i) In leadership assessment and development program in organisations though the Leadership Dimensions Questionnaire (LDQ) (Dulewicz and Higgs, 2003) may be a better option.

ii) In an organisational setting to predict person-job fit and job performance, career planning and development, succession planning etc. where a person's capabilities have to be considered before making a decision.

iii) In performance appraisal by using the self-assessment version or preferably the 360-degree version of DHEIQ.

**2.2.10.5.2 Limitations**

The use of DHEIQ should be avoided

i) In personal assessments by individuals as it was developed to be specifically used in an organisational setting.

ii) In surveys and research on EI as very less information regarding the DHEIQ is available in the public domain besides the availability of a lot many other EI scales which can provide a much more exhaustive measure of EI.

### 2.2.11 EQ Map of Cooper and Sawaf

#### 2.2.11.1 Introduction

The EQ Map was developed by Robert K. Cooper and Ayman Sawaf and included in their book "Executive EQ: Emotional Intelligence in Leadership and Organization" (Cooper & Sawaf, 1998). It is based on the four cornerstone model of emotional intelligence developed by the authors and measures the various components of EQ as well as the competencies, values and outcomes associated with it.

### 2.2.11.2 Format

The EQ map consists of three components viz. questionnaire, scoring grid and interpretation guide though the last one is not included in the norm-testing version of the EQ map. The EQ map questionnaire is divided into five sections consisting of a total of 21 scales as given below.

i) Section I measures the current environment and consists of 3 scales viz. life events, work pressures and personal pressures.

ii) Section II measures emotional literacy and consists of 3 scales viz. emotional self-awareness, emotional awareness of others and emotional expression.

iii) Section III measures the EQ competencies and consists of 5 scales viz. intentionality, creativity, resilience, interpersonal connections and constructive discontent.

iv) Section IV measures EQ values and beliefs and consists of 6 scales viz. outlook, compassion, intuition, trust radius, personal power, and integrity.

v) Section V measures the EQ outcomes and consists of 4 scales viz. general health, quality of life, relationship quotient and optimal performance.

It is a self-report questionnaire where the respondent has to respond to each of the statements under the various scales on a 4-point scale (0 to 3) as per the instructions provided.

### 2.2.11.3 Scoring pattern

The responses to each of the statements under a scale are added to give the overall score on a particular scale, and the process is repeated for all the scales. Finally, the scores in each of the 21 scales are plotted in the EQ map scoring grid to determine the respondent's performance level in each of the scales which is given by 4 performance zones viz. optimal, proficient, and vulnerable and caution.

### 2.2.11.4 Applications

**2.2.11.4.1 Possibilities**

The EQ map can be used

i) By individuals for personal assessment.

ii) For counselling.

However, the EQ map can have widespread applications especially in an organisational setup

i) For coaching and mentoring of employees

ii) As a diagnostic tool to assess the cause of high turnover, poor team performance etc.

iii) As a leadership assessment and developmental tool, vide Goleman's primal leadership concept.

**2.2.11.4.2 Limitations**

Although the EQ map is the result of extensive research and is one of the most practical self-report tests of EQ available, it not advisable to use it

i) In recruitment and selection as self-report measures are susceptible to faking.

ii) In a classroom setting unless for an advanced course on EI as the four cornerstone model it is based on is much more complex than the other basic models of EI.

### 2.2.12 Trait Emotional Intelligence Questionnaire

### 2.2.12.1 Introduction

The "Trait Emotional Intelligence Questionnaire (TEIQue)" is a result of years of research by Konstantin Vasily Petrides at the London Psychometric Laboratory of University College London. It is based on the trait EI theory of Petrides and the original version was published in 2001, but it has undergone many revisions since then (Petrides, 2003).

### 2.2.12.2 Format

The TEIQue is available in the following forms: TEIQue v. 1.50, TEIQue-Short Form, TEIQue-Adolescent Form, TEIQue-Adolescent Short Form, TEIQue-360, TEIQue-360 Short, TEIQue-Child Form, and TEIQue-Child Short Form. Except for the Child Form of TEIQue, the formats of all the other forms of TEIQue are the same varying only in the simplicity of statements. Hence, we will discuss the TEIQue v. 1.50 and TEIQue-Short Form here.

The TEIQue v. 1.50 consists of 153 items which can be grouped under 15 facets of EI, which in turn can be grouped under 4 factors of EI and ultimately to a single global EI score.

The TEIQue-SF consists of 30 items (2 items for each facet) and is supposed to give a global EI score only, though factor scores can also be calculated separately if required.

Both questionnaires to be rated on a scale of 1 to 7, where selecting 1 means that the respondent has strong disagreement and selecting 7 means the respondent has a strong agreement in his viewpoint.

### 2.2.12.3 Scoring pattern

The scoring keys for the shorter forms of TEIQue are available, but the longer forms have to be sent back to the researcher at UCL for scoring. Nonetheless, the scoring process for TEIQue v1.5, in a gist, is as follows.

Some of the items are reversed scored as per the instructions available in the scoring key, and then the 153 items are grouped into 15 EI facets, and the average score is calculated for each facet. Then 13 of the facets are grouped into 4 EI factors, and the score for each factor is calculated as before. Finally, the overall EI score is calculated. All the scores will range between 1 and 7 only. The scores in the 15 facets and the four factors are calculated based on the grouping below.

Factor 1: Well, being made up of the facets of optimism, happiness, self-esteem.

Factor2: Sociability made up of the facets of emotion management, assertiveness, social awareness.

Factor 3: Emotionality made up of the facets empathy, emotional perception, emotional expression, relationships

Factor 4: Self-control made up of the facets of emotion regulation, impulsiveness, and stress management.

The remaining two facets adaptability and self-motivation contribute only to the global trait EI score.

#### 2.2.12.4 Applications

**2.2.12.4.1 Possibilities**

The TEIQue can be used

i) By individuals for personal assessment. The online version of TEIQue developed by K.V Petrides can be used for this purpose and a "development report" obtained almost instantaneously. (Petrides, 2009)

ii) For leadership development in organizations. Both a paper and pencil test and the aforementioned online version of the test can be used for this purpose and a "leadership report" obtained in place of the "development report".

iii) In organisations for 360-degree appraisal using the TEIQue-360 form. A "360 report" can be obtained, as explained in the above points.

iv) For respondents belonging to various age groups by using the appropriate form for each.

v) To obtain stable scores over time in contrast to the other self-report measures of EI where the scores have been found to vary over time for the same respondent.

vi) To relate EI to other variables like mental health, coping style, job performance and satisfaction and deviant workplace behaviour, among others.

Thus most of the applications of TEIQue are pretty unique, and hence it is increasingly preferred over the other available EI measures.

**2.2.12.4.2 Limitations**

Despite the growing optimism regarding TEIQue, it is recommended that its application be avoided

i) In hiring and other job-related decisions where the respondent may have an incentive for faking since TEIQue, like other self-report measures, is susceptible to socially desirable responding ( Mikolajczak et al., 2007).

ii) In studies and settings involving both genders due to the presence of gender differences in trait EI scores unless, of course, separate norms for both the genders have already been established ( Mikolajczak et al., 2007 ). e. g. TEQue can be used in boys or girls only school, but its use should be avoided in a co-ed school.

#### 2.2.13 Genos Emotional Intelligence Inventory

#### 2.2.13.1 Introduction

Gilles E. Gignac developed the Genos Emotional Intelligence Inventory (Genos EI) in 2006 as a revised version of the Swinburne University Emotional Intelligence Test (SUEIT) (Gignac, 2006) which in turn was based on research on six other EI measures and was put forth as an EI test which would measure only pure EI constructs, unlike the mixed model tests which measure both EI and non-EI dimensions.

#### 2.2.13.2 Format

The Genos EI Inventory is available in 3 forms viz. Genos EI Inventory Full Version, Genos EI Inventory Concise Version and Genos EI Inventory Short Version.

The full version (which will be discussed here) consists of 70 items to be rated on a scale of 1 to 5 and provides scores across 7 EI dimensions apart from an overall EI score.

The concise version consists of 31 items and just like the full version, provides both a total EI score as well as seven subscale scores.

The test can be taken in both online as well as pen and paper format.

#### 2.2.13.3 Scoring pattern

The detailed scoring key of Genos EI Inventory is not available, but in a gist, two types of scores can be obtained viz. raw scores for research purpose and percentile scores for professional purpose.

#### 2.2.13.4 Applications

The Genos EI Inventory was specially prepared to be applied in a workplace setting where it can be used

i) To relate EI with job satisfaction and organisational commitment.

ii) In recruitment and selection since, despite being a self-assessment test, it has been found not to correlate very substantially with socially desirable responding.

iii) In training and development to identify the EI skills wanting in the participant and take corrective actions.

iv) To measure the effectiveness of HRD interventions by administering the inventory before and after the intervention.

v) In any study or survey on EI as the Genos EI Inventory, as mentioned earlier, measures only the pure EI dimensions unlike most of the other contemporary tests.

The Genos EI Inventory should not be used

i) In any non-workplace setting and never in a classroom setting where the respondents are below 18 years of age.

ii) In the non-English speaking countries as, unlike the Wong's Emotional Intelligence Scale, which is measurement invariant across cultures, no sufficient research on these lines are available for the Genoa EI Inventory.

#### 2.2.14 Group Emotional Intelligence Survey

#### 2.2.14.1 Introduction

Vanessa Urch Druskat and Steven B. Wolff developed the Group Emotional Intelligence (GEI) Survey in 2003, also known as the Group Emotional Competence Survey. It is based on their socio-emotional theory of group effectiveness and the lines of Daniel Goleman's EI model (Goleman, 1995; Druskat & Wolff, 2003).

#### 2.2.14.2 Format

The Group EI norms can occur at three levels which in turn are based on 6 Group EI dimensions which are further composed of 9 emotionally competent group norms (ECGN) as given below.

**Table 6: Areas and branches of Emotional Intelligence**

|  |  |  |
| --- | --- | --- |
| **Levels** | **Dimensions** | **Norms** |
| Individual | Group awareness of members | Interpersonal understanding |
|   | Group regulation of members | Confronting members who break norms |
|   | Caring orientation |
| Group | Group self-awareness | Team self-evaluation |
|   | Group self-regulation | Creating resources for working with emotion |
|   | Creating an optimistic environment |
|   | Proactive problem solving |
| Cross-boundary | Group social awareness | Organisational awareness |
|   | Group social skills | Building external relationships |

The original version of GEI Survey included just 6 ECGN. The remaining 3 ECGN were added later.

At least 75%-80% of the group members had to complete the questionnaire to be rated on a scale of 1 to 7, where selecting 1 means "very inaccurate" and selecting 7 means "very accurate".

#### 2.2.14.3 Scoring pattern

Some of the items are reverse scored, and then the scores for each of the ECGN are calculated for every member. Finally, average scores are calculated for the entire group, which can then be used to calculate the Group EI.

#### 2.2.14.4 Applications

**2.2.14.4.1 Possibilities**

The GEI Survey can be used

i) In team development

ii) To create social capital this may ultimately lead to group effectiveness.

iv) To reduce conflicts and ensure smoother operations within a group.

v) In research and surveys involving Group EI since unlike individual EI, very few measures are available for Group EI. (Druskat et al., 2003)

**2.2.14.4.2 Limitations**

The use of GEI Survey should be avoided

i) In personal assessment, since not only is individual level EI just a portion of GEI, but the underlying socio-emotional model is also too complicated for a novice to grasp.

ii) In non-western cultures as the survey is relatively new, and all subsequent research has focused mainly on the US population only.

Apart from the above, the GEI Survey cannot be used in mechanistic organisations which are based on hierarchical roles rather than teams.

#### 2.2.15 Positive and Negative Affect Schedule

#### 2.2.15.1 Introduction

The "Positive and Negative Affect Schedule (PANAS)" was developed by D. Watson, L.A. Clark and A. Tellegen. While the Positive Affect (PA) scale measures affective states that are pleasant and activated, the Negative Affect (NA) scale measures aversive mood states and general distress.

#### 2.2.15.2 Format

The PANAS consists of 20 items to be rated on a scale of 1 to 5, where selecting 1 means "very slightly" and selecting 5 means "Extremely", ten items each for PA scale and NA scale. The items are to be rated based on the respondents' feelings in various timeframes like at the moment, today, past few weeks and so on.

There is also a PANAS for Children (PANAS-C) (Laurent et al., 1999) and a PANAS for Children-Parent (PANAS-C-P) (Ebesutani et al., 2011) each consisting of 27 items, 12 items for PA and 15 items for NA. There is also an International PANAS Short Form (I-PANAS-SF) made up of 10 items and an extended version of PANAS called PANAS-X made up of 60 items. However, only the original PANAS will be discussed here.

#### 2.2.15.3 Scoring pattern

The scores for both PA and NA scales are calculated by summing up the respondent's ratings in the ten items composing each of them. In case any item has not been rated by the respondent, the score for that particular scale is calculated as:

(Number of items on scale/number of items answered) X sum obtained from the answered items

#### 2.2.15.4 Applications

**2.2.15.4.1 Possibilities**

The PANAS can be used

i) In a classroom setting as PANAS is the simplest of all the available tests of emotions.

ii) For counselling.

iii) To assess the overall quality of life through the PA scale. (Abbey and Andrews, 1985)

iv) In wellbeing therapy by assessing and enhancing the positive emotions through the PA scale. (Belaise et al., 2005)

v) In stress management as the NA scale can provide the causes of chronic stress. (Larsen et al., 2001)

vi) In the prognosis of fatigue, exhaustion, depression and even various heart conditions.

The PANAS-C-P can have similar uses but is meant only for children to assess their PA and NA from their own as well as their parents' perspectives.

The I-PANAS-SF can be used

i) When there is a time constraint.

ii) In research for pre-test and post-test.

iii) In non-western cultures as well.

**2.2.15.4.2 Limitations**

Despite the popularity and wide-scale use of PANAS and its various versions, it is advisable not to use it in hiring, performance appraisal and other such high stakes decision.

#### 2.2.16 Wechsler Abbreviated Scale of Intelligence, Second Edition

#### 2.2.16.1 Introduction

The "Wechsler Abbreviated Scale of Intelligence (WASI)" was developed by David Wechsler in 1999, and the second edition of scale, WASI-II was published in 2011. It was developed as a shorter alternative to the original "Wechsler Adult Intelligence Scale (WAIS)" and the "Wechsler Intelligence Scale for Children (WISC)".

#### 2.2.16.2 Format

While the WAIS-IV is meant for respondents in the age group of 16-90, the WISC-IV is meant for those in the age group of 6-16, and both the scales consisted of 10 subtests and 5 supplemental subtests to measure four separate IQ indices and an overall Full-Scale IQ.

WASI-II, on the other hand, comes in two forms: one with four subtests and the other with two subtests. The subtests in the longer form are Vocabulary (31-item), Similarities (24-item), Block Design (13-item), and Matrix Reasoning (30-item) and the shorter form consists of just Vocabulary and Matrix Reasoning.

#### 2.2.16.3 Scoring pattern

The WAIS-II 4 subtest form gives three scores as follows.

i) Verbal Comprehension Index (VCI) obtained by adding the scores obtained in Vocabulary and Similarities subtests.

ii) Perceptual Reasoning Index (PRI) score, which is obtained by adding the scores obtained in Block Design and Matrix Reasoning.

iii) Full-Scale IQ (FSIQ) score, which is obtained by adding the VCI and PRI scores obtained as above.

The WAIS-II 2 subtest form just gives the FSIQ score.

#### 2.2.16.4 Applications

The WAIS-II can be used

i) Instead of the two large Wechsler scales when there is a time constraint or administering the full scale is considered unnecessary.

ii) In conjunction with the comprehensive Wechsler scales for preliminary screening or re-evaluation.

ii) In education for developmental purposes by identifying the strong and weak areas of the students and then taking appropriate measures.

iii) In clinical settings to assess brain functioning after an injury or extent of psychiatric illness.

iv) In research to estimate the IQ scores of the respondent sample.

The use of WAIS-II should be avoided

i) In organisational settings as it was purely developed to be used for clinical, research and educational purpose.

ii) In different cultural settings as the WAIS-II norms were obtained from a strictly US sample of 2300 individuals and no definite indication of measurement invariance of the scores across cultures has been found yet.

#### 2.2.17 Sixteen Personality Factors (16PF) Test

#### 2.2.17.1 Introduction

The 16 Personality Factors Test (16PF) was developed in 1949 by Raymond B. Cattell, Maurice Tatsuoka and Herbert Eber. It has undergone various revisions down the years with the presently used 5th edition based on Cattell's 16PF model of personality (Cattell & Schuerger 2003).

#### 2.2.17.2 Format

Apart from the original full version, i.e. the 16PF Fifth Edition, the following forms are also available: 16PF Adolescent Personality Test, 16PF Select Test, and 16 PF Express Test. While the 16PF Adolescent Personality Questionnaire is meant for respondents in the age group of 12 to 18 years, the other two are nothing but shorter versions of the 16PF. Hence, only the 16PF Fifth Edition has been discussed here.

The 16PF consists of 185 situational items (211 items only in case the Couple Counselling Report is to be prepared), and the respondent has to mark True/False beside each. Thus, the 16PF is in stark contrast to other personality measures which are based on self-assessment.

#### 2.2.17.3 Scoring pattern

The responses on the 185 items are scored with the help of the scoring key to give the scores on 16 primary personality traits which can then be grouped into five global personality traits as given below.

i) Extraversion/Introversion which consists of Reserved/Warm, Serious/Lively, Shy/Socially Bold, Private/Forthright, Self-Reliant/Group-Oriented.

ii) High Anxiety/Low Anxiety which consists of Emotionally Stable/Reactive, Trusting/Vigilant, Self-Assured/Apprehensive, Relaxed/Tense

iii) Tough-Mindedness/Receptivity which consists of Warm/Reserved, Sensitive/Utilitarian, Abstracted/Grounded, Open-to-Change/Traditional.

iv) Independence/Accommodation which consists of Deferential/Dominant, Shy/Socially Bold, Trusting/Vigilant, Traditional/Open-to-Change.

v) Self-Control/Lack of Restraint which consists of Serious/Lively, Expedient/Rule-Conscious, Abstracted/Grounded, Tolerates Disorder/Perfectionist.

As is obvious from above, both the scales are bipolar, and scores on three other validity scales are also given, i.e. Impression Management, Infrequency, and Acquiescence.

Various reports are generated like Basic Score Report, Basic Interpretive Report, Human Resource Development Report, Couple's Counselling Report, Karson Clinical Report, Leadership Coaching Report and Teamwork Development Report.

#### 2.2.17.4 Applications

**2.2.17.4.1 Possibilities**

The 16PF can be used

i) In determining the career paths suitable for the respondent by taking the help of the Self-Directed Search. (Holland, 1985)

ii) In HRD activities by assessing the management potential and style.

iii) In counselling by helping in diagnosis, prognosis and therapy planning to identify anxiety, adjustment, and various behavioural problems.

iv) In marriage counselling to predict marital compatibility and satisfaction as well as potential problem areas.

v) To identify students with potential academic, emotional, and social problems.

vi) In various cultural settings by using the different language versions of the 16PF and the accompanying culture-specific norms.

vii) In leadership development interventions.

**2.2.17.4.2 Limitations**

Despite the widespread use of 16PF internationally, its application should be avoided in hiring and other high stake assessments since it is, after all, a self-report measure and is susceptible to faking. However, it is comparatively better than the other personality assessment tests which are based on self-assessment and hence suffer from potential self-estimation bias as well.

#### 2.2.18 Myers-Briggs Type Indicator

#### 2.2.18.1 Introduction

The Myers-Briggs Type Indicator (MBTI) was developed by Isabel Briggs Myers and her mother Katharine Cook Briggs 1942 and was originally called the Briggs-Myers Type Indicator. It was renamed to MBTI in 1956, and the first MBTI manual was published in 1962, the latest and third edition of which was published in 1998. The MBTI is based on Carl Gustav Jung's personality type theory.

#### 2.2.18.2 Format

Various forms of MBTI are available, but the US version discussed here consists of 93 forced-choice questions with the choices being pairs of words or statements, e.g. act first and think later/think first and then act.

The choices are used to determine the respondent's four personality preferences or dichotomies as follows.

i) Extraversion (E)/Introversion (I) indicates whether the respondent focuses on the outer world or the inner world.

ii) Sensing (S)/Intuition (N) which is based on how the respondent assimilates information.

iii) Thinking (T)/ Feeling (F) which is based on the decision-making style of the respondent.

iv) Judging (J)/ Perceiving (P) which is nothing but the respondent's outlook towards life and the outside world.

Based on the preferences, the candidate falls under any of the 16 possible personality types which are nothing but combinations of the 4 dichotomies mentioned above, e.g. ISTJ, ENFP etc.

#### 2.2.18.3 Scoring pattern

The pen and paper test can be taken through a certified professional who then calculates the scores or the test can be taken online at CPP's website and the MBTI profile report generated which ultimately gives the personality type of the respondent based on his preferences as mentioned before.

The respondent may also complete a Best Fit Exercise to predict his personality type, which can then be compared with the MBTI reported type.

#### 2.2.18.4 Applications

**2.2.18.4.1 Possibilities**

The MBTI can be used

i) In determining the career paths suitable for the respondent. For instance, an INFP can be a researcher or professor.

ii) In personality development with the help of the MBTI practitioner's feedback.

iii) In determining the most appropriate learning style for the respondent based on his type.

iv) In teambuilding by determining the communication style of the members.

v) In counselling.

vi) In various cultural settings by using the different language versions of the MBTI and the accompanying culture-specific norms.

vii) In leadership development interventions.

viii) In employee relations by analysing the various human natures.

ix) To develop effective problem-solving, planning, and decision-making strategies.

**2.2.18.4.2 Limitations**

Despite the widespread use of MBTI, it is recommended that its application be avoided

i) In recruitment and selection since it evaluates the respondent's preferences and not his actual abilities.

ii) In any study or activity where the personality traits if the respondent needs to be analysed as MBTI just gives the respondent's personality type.

iii) In performance appraisal as the MBTI manual explicitly states that it is not a good predictor of job performance.

#### 2.2.19 Belbin Team Role Inventory

#### 2.2.19.1 Introduction

The Belbin Team Role Inventory (BTRI) or simply Belbin Team Inventory was developed in Meredith Belbin. It was first published in his book "Management Teams: Why They Succeed or Fail" in 1981 based on his research in Henley Management College, and it has undergone quite a few revisions since.

#### 2.2.19.2 Format

Unlike the other personality inventories, the BTRI does not measure individual personality type but measures the respondent's behaviour in a team setting based on a 360-degree feedback questionnaire.

As the BTRI was copyrighted, so neither the items nor the scoring pattern is available in the public domain. However, in a gist, it can be said that the BTRI consists of a series of statements, each followed by several responses and the respondent has to allocate 10 points to these responses as he deems fit, and so on for all the statements.

#### 2.2.19.3 Scoring pattern

After the respondent has completed the inventory as mentioned above, the scores are calculated for each of the 9 team, which determines the respondent's tendency towards that particular role. Contrary to a respondent being associated with a single personality type, here, a respondent may display a strong inclination towards multiple roles. The 9 roles can, in turn, be grouped under 3 different heads, as shown below.

i) Action-oriented roles: Shaper (SH), Implementer (IMP), Completer-Finisher (CF)

ii) People-oriented roles: Coordinator (CO), Team worker (TW), Resource Investigator (RI)

iii) Thought oriented roles: Plant (PL), Monitor-Evaluator (ME), Specialist (SP)

#### 2.2.19.4 Applications

**2.2.19.4.1 Possibilities**

The BTRI can be used

i) In team building to result in a balanced team.

ii) In personal assessment by the respondent to develop his strengths and manage the weaknesses as a team member.

iii) To motivate the team members by assigning them roles they show an inclination for thus ultimately leading to better team performance.

iv) To reduce conflicts and ensure smoother operations within a team.

v) Along with "Belbin Job Requirements Inventory" for performance evaluation of the respondent.

**2.2.19.4.2 Limitations**

The use of BTRI should be avoided

i) In surveys or research since there is dissonance regarding the number of role constructs as well as the measure's reliability and validity. (Fisher et al., 2001)

ii) When the team is engaged in a long term project since the BTRI does not take into account the various stages of team development.

Apart from the above, the BTRI cannot be used in mechanistic organizations or bureaucracies which have a hierarchical structure rather than teams.

#### 2.2.20 Leadership Practice Inventory

#### 2.2.20.1 Introduction

James M. Kouzes and Barry Z. Posner developed the Leadership Practice Inventory (LPI). It is based on their "Five Practices of Exemplary Leadership" model, first propounded in their book "The Leadership Challenge", in 1987. It is one of the most comprehensive and most widely used 360-degree leadership measures available.

#### 2.2.20.2 Format

The LPI is available in three forms: LPI 360, LPI Individual and Student LPI. The LPI 360 incorporates two separate tools viz. the LPI Self which is completed by the leader and the LPI Observer, which is completed by at most ten respondents selected by the leader. The LPI Individual is nothing but the LPI Self when used in isolation for self-assessment by the leader. The Student LPI, on the other hand, is similar to the LPI 360 but is meant for students and young leaders only. Thus, due to their similar construct, a discussion on LPI 360 alone is done here.

Both the LPI Self and LPI Observer consist of 30 items that measure the 5 leadership practices (6 items each) as mentioned below.

i) Model the Way, which includes items like "Sets a personal example of what is expected."

ii) Inspire a Shared Vision, which includes items like "Describes a compelling vision of the future."

iii) Challenge the Process, which includes items like "Seeks challenging opportunities to test skills."

iv) Enable others, which include items like "Treats people with dignity and respect."

v) Encourage the Heart, which includes items like "Finds ways to celebrate accomplishments."

#### 2.2.20.3 Scoring pattern

The average scores of all the respondents for the LPI Observer including manager, direct reports, co-worker and others are obtained for each of the 30 items of LPI.

The LPI feedback report then provides the scores in the following formats:

i) Leadership Behaviours ranking provides the score for each of the 30 items of both the LPI Self and LPI Observer arranged in decreasing order of the average LPI Observer scores.

ii) Individual Practices Data Summary provides both the LPI Self and LPI Observer (both respondent wise and average) scores for each of the items under a particular leadership practice.

iii) Overall Data Summary provides both the total LPI Self and total LPI Observer (both respondent wise and average) scores for the five leadership practices (obtained by summing up the scores of the six items comprising the leadership practice).

iv) Percentile Ranking shows how the leader fares (Low, Moderate, High) in terms of the LPI Self and LPI Observer scores for the five leadership practices as compared to all those who have taken the test so far.

#### 2.2.20.4 Applications

The LPI Individual can be used

i) By individual consultants, training and human resource professionals as well as emerging leaders for self-assessment and development by identifying and working on the leadership practices where improvement is possible.

ii) In leadership workshops meant to expose the participants to the models and measures of leadership.

iii) To assess the effectiveness of a leadership development program by analysing the LPI scores before and after the intervention.

iv) Safely in any research and survey on leadership as LPI is one of the most comprehensive and widely researched tools available for leadership.

The LPI 360 can be used

i) To assess and nurture the leadership potential in individuals at all levels in an organization.

ii) In career development and succession planning.

The Student LPI can be used

i) As a stepping stone for students in the vast realm of leadership.

ii) To identify potential future leaders and provide mentoring where required.

Despite the optimism regarding LPI and its widespread use, it should be kept in mind that LPI is based on a relatively old model of leadership and a lot of new exciting models have emerged since then which provide a new outlook towards leadership. Hence, over-reliance on a single measure of leadership should be avoided, and the other measures should be explored as well.

#### 2.2.21 Multifactor Leadership Questionnaire

#### 2.2.21.1 Introduction

The Multifactor Leadership Questionnaire (MLQ), also known as MLQ 5X short, was developed by Bernard M. Bass and Bruce J. Avolio in 1995 based on Bass' concept of transformational leadership (1985). It has undergone revisions from time to time, the latest being in 2004.

#### 2.2.21.2 Format

The MLQ is a 360-degree measure of leadership and includes both self and rater forms with the rater comprising of superiors, subordinates, peers and others.

The MLQ consists of 45 items to be rated on a 5-point frequency scale by the concerned respondent as mentioned before and ranges from 0= "Not at all" to 4= "Frequently, if not always".

The 45 items measure nine leadership factors that can be grouped under three leadership styles and also three leadership outcomes.

#### 2.2.21.3 Scoring pattern

The average scores for each of the nine factors and the outcomes are calculated separately for both the self and rater forms. The average scores for each of the leadership styles can then be calculated according to the grouping mentioned before, again separately for the two forms.

The MLQ 360 Leader's Report then gives a comparison of the self and rater scores through bar graphs along with the various norms, e.g. universal, national etc.

#### 2.2.21.4 Applications

**2.2.21.4.1 Possibilities**

The MLQ can be used

i) For self-assessment by self-guided leaders by using only the self-rating version of the MLQ.

ii) To create a leadership development plan (LDP) which is given in the MLQ Leader’s workbook, which can be used by individual consultants, trainers and teachers as well as emerging leaders.

iii) In leadership workshops meant to expose the participants to the neo-charismatic theories of leadership and the corresponding measures.

iv) To assess the effectiveness of a leadership development program by analysing the MLQ scores before and after the intervention.

iv) Safely in any research and survey on leadership as MLQ is a well-developed tool which has undergone many revisions to remove its various shortcomings.

v) Across multiple cultures and organizations.

vi) When there is a time constraint as it consists of only 45 items and takes just about 15 minutes to complete.

**2.2.21.4.2 Limitations**

The use of MLQ should be avoided in hiring, performance appraisal or any other high stakes decision since MLQ is, after all, a self-report measure and hence is susceptible to faking either to inflate score in a particular dimension (in case of self-rating measure) or under external pressure (in case of rater’s form).

Apart from that, various new theories of leadership and their corresponding measures have been developed in the last decade, e.g. Leadership Development Profile, which can prove to be exciting alternatives to MLQ.

**Table 7: Various Tests of EI**

|  |  |  |  |
| --- | --- | --- | --- |
| **Name of the EI test** | **Developed By** | **Basis** | **Structure** |
| Mayer-Salovey-Caruso Emotional Intelligence Test  | John Mayer, Peter Salovey and David Caruso (2002) | Ability model of EI (Salovey & Mayer; 1990, 1997) | The scale has 141 items grouped into various tasks and divided into categories.  |
| Trait Meta-Mood Scale  | Salovey et al. in 1995 | State Meta-Mood Scale (SMMS) of Mayer and Gaschke | The TMMS has 30 items to be measured on a scale of 1 to 5, where selecting 1 means “strong disagreement” and selecting 5 means “strong agreement.” |
| Wong and Law Emotional Intelligence Scale | Chi-Sum Wong and Kenneth S. Law (2002) | Chi-Sum Wong and Kenneth S. Law | The WLEIS consists of 16 items to be rated on a scale of 1 to 7. |
| Wong’s Emotional Intelligence Scale | Wong et al. (2004) | Predecessor, the Wong and Law Emotional Intelligence Scale | The WEIS consists of 40 items divided into two parts of 20 items each. |
| Tapia Emotional Intelligence Inventory | Martha Tapia (2001) | Ability based model of emotional intelligence | It consists of 41 items. There are four subscales.  |
| Schutte self-report Emotional Intelligence Test | Nicola Schutte (1998) | Mayer and Salovey’s ability-based model of emotional intelligence | The SSREIT consists of 33 items to be rated on a scale of 1 to 5 |
| Emotional Quotient Inventory  | Reuven Bar-On(1997) | Capabilities to approach to EI | This test consists of 133 items.  |
| Group emotional intelligence survey  | Vanessa Urch Druskat and Steven B. Wolff (2003) | Socio-emotional Theory of group effectiveness | Survey has three levels. |
| Myers-Briggs Type Indicator  | Isabel Briggs Myers & Katharine Cook Briggs (1942) | Carl Gustav Jung’s Personality Development Theory | The test consists of 93 questions. The choices are paired.  |
| Belbin Team Role Inventory | Meredith Belbin (1976) |  | The test has much staconsist of series of statement each followed by nutements followed by responses. The subject assigns a point to the references.  |
| Leadership Practice Inventory  | James M. Kouzes and Barry Z Posner (1987) | Five Practices of Exemplary Leadership model.  | There are three varieties of LPI, namely Lpi 360, LPI individual and LPI leader.  |
| Multifactor Leadership Questionnaire | Bernard M. Bass and Bruce J. Avolio (1995) | Bass concept of Transformational leadership.  | The scale consists of 45 items based on a 5-point frequency scale.  |

## 2.3 Machine Learning

This section introduces the fundamentals of Artificial intelligence and Machine Learning (ML). The section has been organized as follows. This sub-section introduces Artificial Intelligence and Machine Learning. The next section presents a brief about the classifiers used in the thesis. The third subsection presents the use of classifiers in regression, and the fourth explains feature selection and reduction.

ML is classified into supervised or unsupervised learning. Supervised learning is widely used and is the most popular ML technique. In supervised learning, labelled data is used to train the machine-learning model. Even though the data fields need to be labelled accurately for this method to work, supervised learning is extremely useful and result oriented if it is used in favourable conditions. Supervised learning problems are grouped into regression and classification problems. Classification supervised learning problems involves predicting a class label, whereas regression learning problems involves predicting a numerical label.

Conversely, in unsupervised learning data is without labels. There is no instructor or supervisor required to supervise in unsupervised learning, and clustering is done. In reinforcement learning, history is used in an attempt to predict the future. Thus ML techniques have a large variety of applications such as Image and Speech Recognition, Medical Diagnosis, [Classification](https://data-flair.training/blogs/machine-learning-applications/), [Statistical Arbitrage](https://data-flair.training/blogs/machine-learning-applications/), [Prediction](https://data-flair.training/blogs/machine-learning-applications/), [Extraction](https://data-flair.training/blogs/machine-learning-applications/), [Regression](https://data-flair.training/blogs/machine-learning-applications/) and many others. Mostly, the dataset has a large number of features, so it takes much time to compute, and more memory is needed for processing and storage of the data. Visualisation of such data is always difficult because of its size.

In the models proposed in this thesis, two classifiers, namely: Neural Networks and Support Vector Machines have been used for finding the discriminative power of the features. This subsection section briefly introduces the classifiers, feature selection and feature extraction methods.

### 2.3.1 Classifiers

#### 2.3.1.1 Neural Networks

Despite all the advances that the scientific fraternity has made, many problems in object recognition, classification and regression remain unresolved. However, these problems can be easily solved by a human brain. The human brain works in a markedly different way vis-à-vis a conventional computer. The human brain works astoundingly, owing to its ability to work as a parallel computing system. When eyes see a person, the brain starts working with the help of neurons. The ability of the brain to recognise the person is not only because of what is there in the cranium but because of what is referred to as mind. The brain, along with millions of neurons and trillions of the synapse, works as a powerful parallel computer and helps us to recognise a person or a place, or say for that matter an event, in approximately 200-300 ms (Haykin 2008; McCulloch and Pitts W 1943). A standard desktop computer would take much more time to accomplish a task much more straightforward than the above. The neurons have a cell body, soma, dendrites and axon (Anderson 1995). A neuron is connected to another through a synapse. The synapse forms a neural microcircuit to produce the necessary functionality (Anderson 1995). The neurons form the local circuit, which forms the interregional circuit, which finally forms the central nervous system (Rojas 1996). A neural network mimics the above network. A network would always have an input layer and an output layer. It may, however, have more layers. A simplest neural network has just two layers, the input and the output layer (Padhy & Simon 2015). The input is connected to the output, but the output is not connected to the input. This is called a feed-forward network. The network has been depicted in Figure 2.

Input layer

Output layers of neurons

**Figure 2: Single Layer Feed Forward**

In a multilayer feed-forward neural network there may be more than two layers: the input layer is directly connected to the hidden layer, which in turn is connected to the output, but the output is not connected to the input (Zureda 1996). Such a network has been shown in Figure 3.

Input layer

Output layers of neurons

Hidden layer

**Figure 3: Multilayer Feed Forward**

The feedback Neural Network evaluates the weights of the later layers, and using these weights finds the weights of the initial layers. Neural Networks use data for training the network for this purpose. If one of the outputs, say y1, depends on x1, x2, x3, ..,xn. The coefficients w11, w12, w13, ..., w1n, multiplied to xis would be input to the function f which determines the output. That is, where f is the function that takes the linear combinations of xis and produces the value of y1. If f is a step function, then y1 would be either 0 or 1.

This simple concept can be used to create a classifier. The input can be extended to include b, the bias, which can be considered as an input to the unit weight. In this case, the input would be. If f is a sigmoid function, the value obtained would be an indicator of the level to which the inputs are associated with the outputs (Haykin 2008).

The above concept can be extended to a two-dimensional array as a weight matrix, the input matrix and a column matrix depicting the output. The proposed model uses multilayer feedback neural network for regression.

### 2.3.1.2 Support Vector Machine

In Machine learning, a support vector machine (SVM) is a supervised learning-based model. SVM mainly uses a classification algorithm for classification problems. SVM is also a suitable model to be used for regression problems. The purpose of SVM is to discover a requisite optimal hyperplane having N number of features, differently classifies the data points. A classifier classifies a given an example, and it can be performed in numerous ways, one of which is to define the requisite hyperplane. The labelled data is used as input to an SVM algorithm. Data points are classified with the help of decision boundaries, known as hyperplanes.

In SVM, the dimensions of the plane rely on the no. of features. Hyperplane act as a line in the case, two features are taken as input, whereas in case, three features are taken as input, then the plane is a 2-D hyperplane. However, if these features exceed three, then it became difficult to imagine the hyperplane. Support Vectors (SVs) are used to help in building SVM. If these support vectors are very close to the plane, then they affect the position and viewpoint of the hyperplane—SVs help to make most of the margin of the classifier. Removing these SVs results in the shift in the location of the plane.

### 2.3.2 Machine Learning and Regression using Neural Network

Machine Learning algorithms and techniques follow training –testing method. Model take knowledge by training dataset and this model is applied to new test dataset for results. As already discussed, the learning may be supervised (labelled) learning or unsupervised learning (without the label). ML algorithms are applied to many problems similar to health applications, e-commerce applications, and image processing etc. In ML, learning is the use of previous experiences to gain more accurate future predictions. ML deals with both classification (feature-based) and regression problems (numerical value-based).

The architecture of the human brain inspires a neural network. A neural network is essentially an ML model used in unsupervised learning. A neural network is a network of connected points each responsible for some simple computation. These nodes act similar to the neurons in the human brain. NN is made of input, hidden, and output layers of connected neurons. Every node is similar to MLR; these MLR produce singles and feeds to an activation function that may be non-linear.

**Table 8: Terminology of Machine Learning**

|  |  |
| --- | --- |
| **Inductive bias** | Inductive bias of a learning algorithm is based on a set of assumptions used by the learners for prediction of output by providing unobserved or unseen inputs.Nearest neighbours in clustering and Maximum margin in SVM are commonly used ML models. |
| **Generalization** | In ML, the training set is required to train each model before try to forecast the correct result on the test dataset is called Generalization. [Alpaydin, 2010] |
| **Underfitting** | When an ML model fails to separate the specific outline in the data, and it does not perform well even on training data is underfitting. Model is not trained too much to avoid overfitting.  |
| **Overfitting** | In overfitting, a model is trained on data almost flawlessly but results poorly on validation and test dataset.  |
| **Validation dataset** | In the validation or development set, the dataset is used to adjust the hyperparameters of a classifier. It generally used to minimize overfitting.  |
| **Cross-validation** | Cross-validation or rotation estimate is a method reserve a specific sample of a dataset on which the model is not trained earlier. |
| **Test set** | After training and validation of data, the test dataset is used with unseen data. Same probability distribution application on the test dataset, as used in the training dataset. |

In the ML model, in the training dataset, features describe the values of labels. Features and labels in a dataset considered independent and dependent variables. Regression is to discover the association between independent and dependent variables (Tsochantaridis, 2005). Another type of regression is statistical regression which shows that these values are mutually dependent on each other (Smithson, 2006). The model has been used for the prediction of unknown values. The Least Square Method (LSM) for discovering the unidentified coefficient is a kind of statistical techniques. Nowadays, the neural network method is used for analysis purpose.

In the Neural Network model, if the training data is (X, Y) where,

X= {x1, x2, x3,……,xn}

Y= {y1,y2,y3……, yn} , where X is the dependent variable (s) and Y is the independent variable

The technique attempts to find W, such that

Y=WX+W0, where Y and X are matrices.

In the NN model, an additional input x1=1 can be taken to account for the bias. In linear perception, the output is W.X, which needs to be corrected by Gradient Decent. The Gradient Descent method seeks to minimize the mean squared error. The minimum value of the function can be reached by differentiating E w.r.t W and subsequently putting the derivative equal to 0. In the formula that finds the weight in the next iteration, the learning rate is incorporated. If the value of the coefficient representing the learning rate is too small, the conversion would be slow.

On the other hand, if the value is too large, there can be many oscillations. This rule is generally referred to as Delta rule, Gradient rule or the Root Mean Square Technique. This technique guarantees the best possible solution but is remarkably slow.

### 2.3.3 Feature Selection and Reduction

The classifiers explained above use data with many features. If a data with greater no. of features is selected as an input, then the computational and processing time is increased. Even the data need a large memory space for storage. The results are also hampered owing to failure to visualise the data. It may be noted that not all the features are related to the job. Therefore, the feature reduction is used by selecting the most relevant features.

There are many ways of selecting a subset of features. In the first strategy, (d-k) features are selected from d features using some criteria. Sequential Forward Feature Selection, Sequential Backward Feature Elimination and Branch and Bound are some of the techniques of feature selection (Duda and Hart 2012).

### 2.3.3.1 Subset Selection

Initially, the data has d features, and the purpose of feature selection is to select a subset that gives the best result. The problem, therefore, reduces to finding the optimal subset of the given set of features. It is computationally expensive to elucidate all the 2n subsets and then find the best subset. Therefore, other approaches like Branch and Bound and Greedy are used to find the optimal solution. The sequential forward feature selection selects the first k best features and leaves (d-k) features. The sequential backward feature elimination, likewise, eliminates some feature and keeps the remaining (Cha 2011; Bishop 2006). The floating method selects k features and eliminates l features (Duda and Hart, 2012; Alpaydin 2014). Except for the above branch and bound method, which uses a monotonic function J, to decide a branch which is to be explored (and others to be left), can be used.

### 2.3.3.2 Feature Reduction

The Factor Analysis method is based on the probabilistic model, and the estimation of parameters is done using the Expectation-Maximization algorithm. In factor analysis, the data x is modelled as approximately lying in k dimensional space (k<n).

The data roughly lies in the subspace identified by Principal Component Analysis (Duda, 2012). It requires the calculation of the Eigenvalues. Here, we pre-process the data to normalise mean and variance; and then find the direction in which the scatter-ness is maximum. The direction can be found by finding the Eigenvector corresponding to the maximum Eigenvalue of SST.

However, the direction of maximum variance may not be ever used for classification. The Fisher Linear Discriminant finds projection to the straight line so that the samples of the different classes are well separated. Here, the projection is on the line which maximises.

# CHAPTER 3

# RESEARCH OBJECTIVES & HYPOTHESIS

## 3.1 Research Objectives

1. To assess the importance of emotional intelligence in qualitative market research techniques.

 1a. To detect the emotions from the facial images.

2. To automate the measurement of emotional intelligence.

 2a. To find the essential feature out of an emotional intelligence measurement test

2b. To find missing data out of an emotional intelligence measurement test.

### 3.2 Hypothesis

**H01**: There is no significant relationship in emotional intelligence and qualitative market research techniques.

**Ha1**: There is a significant relationship between emotional intelligence and qualitative market research techniques.

**H02:** Emotion on faces cannot be detected using images.

**H a2:** Emotion on faces can be detected using images.

**H03:** Features of the existing emotional intelligence test cannot be ranked according to their importance.

**Ha3:** Features of the existing emotional intelligence test can be ranked according to their importance.

**H04:** Missing data while measuring emotional intelligence using existing test cannot be predicted.

**Ha4:** Missing data while measuring emotional intelligence using existing test can be predicted.

## 3.3 Conceptual Framework:

A conceptual framework to find the essential feature out of Emotional Intelligence measurement test using feature selection is proposed in Figure 4 and to find missing data out of Emotional Intelligence measurement test using regression in Figure 5. A conceptual framework to detect the emotions from the images by face detection is proposed in Figure 6.



**Figure 4: Pipeline to find the essential feature out of Emotional Intelligence measurement test**



**Figure 5: Pipeline to find missing data out of Emotional Intelligence measurement test**



 **Figure 6: Pipeline for Emotion detection using Images**

#

# CHAPTER 4

# RESEARCH METHODOLOGY

##

## 4.1 Universe and Survey population

The universe of the research study is the senior qualitative market researchers working in big market research companies irrespective of their gender.

## 4.2 Sampling technique

Convenience sampling is used in the research study. In this study, the sample was taken from those who can be conveniently approached.

## 4.3 Sample Size

The questionnaire had been mailed to 200 senior qualitative market researchers working in big market research companies irrespective of their gender, out of which 138 persons responded to the questionnaire. The sample chosen was representative of the population, as the ethos of the sample was the same as that of the desired population.

## 4.4 Variables

Variables drive the research process and keep the curiously of research to a high enough level. These variables, as mentioned in table 7, have been studied in the current research.

**Table 9: Variables**

|  |  |
| --- | --- |
| **Independent Variables** | **Dependent variable** |
| Attention to Feelings  | Emotional Intelligence Quotient  |
| Clarity of Feelings  |
| Mood Repair  |
| Life Orientation  |

##

## 4.5 Data collection

### 4.5.1 Data for emotion detection from images

Publicly available data was used from Labelled Faces in the Wild (LFW). LFW is a database of face photographs and is freely available to all for research. It contains more than 13,000 images of faces with each face labelled with the name of the related person. This research includes 60 pictures of one person divided into four categories: Happy, Angry, Sad and Shocked. All the images were taken in a JPEG file format.



**Figure 7: Labelled faces in the wild**

The dimensions of all the photos are 150 x 150 pixels and a size of 6- 9 Kilobytes. All the pictures have a horizontal and vertical resolution of 96 dpi and a bit depth value of 24.

**Figure 8: Proposed method for calculating the rank of features**

**Figure 9: Proposed framework for detecting emotions from Images**

### 4.5.2 Data for selecting the most important features and regression using ML

Standardised questionnaire Trait Meta-Mood Scale developed by Salovey et al., (1995) was adopted to finalise the instrument for the current study. The instrument is in Appendix A

## 4.6 Data pre-processing and analysis

## 4.6.1 Pre-Processing of data

## 4.6.1.1 Pre-Processing of images data

All the images were downloaded and organised into four folders according to the emotion shown in the picture. Then the file of the labels was stored, and the path was set in Anaconda (Python) for classification purposes. Pre-processing of images was not required as each image was available in four variations. We have used the best possible image for this research.

## 4.6.1.2 Pre-processing of text data collected from qualitative market researchers

The data was pre-processed and then subjected to the experiment. First of all, missing values were filled as follows. If for a particular person, the majority of the fields were incomplete; then this data was not used. In other cases, regression analysis was applied to fill the unknown values.

## 4.6.2 Data Analysis

## 4.6.2.1 Feature Extraction to detect the emotions from the images by face detection

Feature extraction was done using Principal Component Analysis. All the data from the images were read in a 2D array. Then this 2D array was converted to a 1D array, and later all the values were subtracted from the mean value to obtain an array d. Now the product of d and its transpose was taken to get a coherence matrix. The Eigenvalue and Eigenvector of this matrix were obtained. The Eigenvector corresponds to the direction of maximum scatter, whereas the Eigenvalue corresponds to the weight of the vector.

The feature selection was made using the Fisher Discriminant Ratio, and the classification was done using classifiers.

## 4.6.2.2 Feature Selection to find the essential feature out of Emotional Intelligence measurement test

The classifiers use data with many features. If the number of features of the data is large, it takes more time for computation, and more memory is required to store and process the data. The understanding of the results is also hampered because of failure to visualize the data.

There are many ways of selecting a subset of features. In the first strategy, (d-k) features are selected from d features using some criteria. Sequential forward feature selection, sequential backward feature elimination and branch and bound are some of the techniques of feature selection. In feature extraction, the $x\_{i}, i=1 to d$, is reduced to $z\_{i}, i=1 to k, k<d$. Principal Component Analysis, Fisher Discriminant Analysis and Factor Analysis are some of the techniques of feature elimination.

In Filter methods, the affinity of a feature with the label is determined. In order to discover the most relevant features, Fisher Discriminant Ratio (FDR) has been used in work. FDR is given by

$$FDR=(m\_{1}-m\_{2})^{2}/(s\_{1}^{2}-s\_{2}^{2})$$

Where,

$m\_{1} $is the mean of the first class

$m\_{2} $is the mean of the second class

$s\_{1} $is the standard deviation of the first class

$s\_{2 }$is the standard deviation of the second class

### 4.7. Support Vector Machine for classifying images based on emotions

Feature extraction was done using Principal Component Analysis(PCA). The feature selection was made using the Fisher Discriminant Ratio(FDR), and the classification was done using the Support Vector Machine (SVM).

The SVM finds three lines, where the distance between the extreme two, that is margin, is as far as possible, and the middle one is chosen as the requisite one (Duda, 2015). This is because if the selected line is too close to the training points, it would be overly sensitive to the noise. Although the discussion that follows deals with a two-dimensional plane, the concept can be extended to a multidimensional plane as well.

A hyperplane can be represented as follows (Alpaydin, 2017; Duda, 2015).

                                $f\left(x\right)= β\_{0}+ β^{T}x$                                                                    (1)

Here, is the weight vector and is the bias.

From amongst infinite hyperplanes possible, the one satisfying the following relation is chosen. Where,

                                         $\left|β\_{0}+ β^{T}x\right|=1$                                                                 (2)

The x is the training examples that are closest to the hyperplane. These would, henceforth, be referred to as the support vectors. Also, the distance between the points needs to be maximised, that is

$distance= \frac{\left|β\_{0}+ β^{T}x\right|}{\left|\left|β\right|\right|}$            (3)

And

                   $ distance (supportvectors)= \frac{1}{\left|\left|β\right|\right|}$                      (4)

The margin would therefore be $\frac{2}{\left|\left|β\right|\right|}$. Hence, the value of ½ $\left|\left|β\right|\right|^{2}$ would be minimized to achieve the task.

 (5)

Where,  denotes each of the labels of the training examples.

## 4.8 Neural Network for regression to find missing data

Neural Network has been used to carry out the regression. The model has been implemented and has been tested with the data collected. The experiment has been repeated 100 times, and the results suggest that the technique is not only effective but is also efficient as compared to the conventional methods.

The neurons, in turn, form the local circuit, which in turn form the interregional circuit, which finally forms the central nervous system. A neural network mimics the above network, and it will always have an input layer and an output layer. It may, however, have more layers. A most straightforward neural network has just two layers, the input and the output layer. The input is connected to the output, but the output is not connected to the input. This is called a feed-forward network. A neural network may also have more than two layers the input, the output layer and hidden layers in between. The input is connected to the hidden, who in turn are connected to the output, but the output is not connected to the input. This is called a multi-layer feed-forward model.

The feedback Neural Network evaluates the weights of the later layers, and using these weights finds the weights of the initial layers. Neural Networks use data for training the network for this purpose. If one of the outputs, say y1, depends on x1, x2, x3, .., xn. The coefficients w11, w12, w13, ..., w1n, multiplied to xi’s would be an input to the function f which determines the output. That is $y\_{1}=f(w\_{11}x\_{1}+w\_{12}x\_{2}+…+w\_{1n}x\_{n})$, where f is the function that takes the linear combinations of xi’s and produces the value of y1.If f is a step function, then y1 would be either 0 or 1 depending upon whether $w\_{11}x\_{1}+w\_{12}x\_{2}+…+w\_{1n}x\_{n}>0$ or it is less than 0.

It can be used to create a classifier. The input can be extended to include b, the bias, which can be considered as an input with unity weight. In this case, the input would be$b+w\_{11}x\_{1}+w\_{12}x\_{2}+…+w\_{1n}x\_{n}$. If f is a sigmoid function, the value obtained would be an indicator of the level to which the inputs adhere to the output.

The above concept can be extended to a two-dimensional array as a weight matrix, the input matrix and a column matrix depicting the output. This work uses a multilayer feedback neural network for regression.

# CHAPTER 5

# EXPERIMENT, OBSERVATION AND ANALYSIS OF DATA TO AUTOMATE THE MEASUREMENT OF EMOTIONAL INTELLIGENCE

The work aims to develop an automated system to facilitate the measurement of EI. To that aim,

a) We developed a method to find the most discriminative features of the data. The method has been applied to the stated dataset, but it will work for any dataset, including the imaging dataset.

b)     Missing data have been found using regression.

c)      Images have been classified using the principal component analysis method.

## 5.1 Experimental results on the detection of emotions from the facial images

This experiment aimed at classifying emotions using facial images. The experiment used 60 pictures in total with 15 from each group. The details of the pictures have been provided in the previous section. This section throws light on the experiment. Each picture was converted into an array. An array of $150×150×3 unit8$ was created using the imread function. This was followed by converting the array into a 1-dimensional array and converting the resultant array into a double array (of size $67500×1 doublearray$). The experiment was performed by taking two groups at a time. That is, one against all approach was used for classification. The first two groups had 30 images out of which 24 images were selected. The array containing the information of all the images, therefore, had 24 rows and 67,500 features. The principal component analysis was used for dimensional reduction. The dimensions along which the variance is maximum can be chosen using PCA. The application of principal component analysis in the present data resulted in $23×24$ array.

The transformed space thus had 24 features. The features were then ordered using FDR. Forward feature selection was then used to find the most relevant features. One feature was selected at a time, and the SVM was applied for classification. For the first ten features, there was no appreciable change in accuracy. The accuracy was then noted by increasing the number of features one at a time. The results for the first two groups are as follows (Table 5). Figures 10, 11 and 12 show the variation of accuracy, specificity and sensitivity with the number of features. Laugh vs Angry. Minimum of 10 features was required to achieve a minimum accuracy of 75%. The best result was obtained when the number of features is 15.

**Table 10: The results of forward feature selection: Accuracy, Specificity and Selectivity:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Features** | **Accuracy** | **Spec** | **Sensitivity** |
| 10 | 0.788889 | 1 | 0.766667 |
| 11 | 0.788889 | 0.992857 | 0.783333 |
| 12 | 0.788889 | 0.992857 | 0.775 |
| 13 | 0.794444 | 0.992857 | 0.72 |
| 14 | 0.783333 | 0.984524 | 0.783333 |
| 15 | 0.8 | 1 | 0.716667 |
| 16 | 0.772222 | 1 | 0.791667 |
| 17 | 0.783333 | 1 | 0.141667 |
| 18 | 0.783333 | 0.985714 | 0.183333 |
| 19 | 0.777778 | 0.985714 | 0.158333 |
| 20 | 0.811111 | 0.992857 | 0.758333 |
| 21 | 0.8 | 0.985714 | 0.766667 |
| 22 | 0.794444 | 0.984524 | 0.733333 |
| 23 | 0.811111 | 0.985714 | 0.791667 |
| 24 | 0.816667 | 0.984524 | 0.716667 |

**Figure 10: Results of forward feature selection: Accuracy v/s the number of features, Laugh vs Angry**

**Figure 11: Results of forward feature selection: Specificity v/s the number of features, Laugh vs Angry**

**Figure 12: Results of forward feature selection: Sensitivity v/s the number of features, Laugh vs Angry**

It may be noted that at least ten features are required to get an accuracy of above 75%. According to the table, the maximum accuracy (0.8) was achieved when the number of features in the transformed space was 15. At this point, the specificity was 1. Likewise, observations were recorded for the second and the third group and the third and the first group. This was followed by plotting the graphs of accuracy with the number of features, specificity with the number of feature and sensitivity with the number of features. For the third and the first group, the maximum accuracy (0.81) was achieved when the number of features in the transformed space was 17. At this point, the specificity was 0.91. For the first and the fourth group, the maximum accuracy (0.8) was achieved when the number of features in the transformed space was 17. At this point, the specificity was 0.93. For the second and the third group, the maximum accuracy (0.82) was achieved when the number of features in the transformed space was 17. At this point, the specificity was 0.91. For the second and the fourth group, the maximum accuracy (0.79) was achieved when the number of features in the transformed space was 13. At this point, the specificity was 0.89.

For the third and the fourth group, the maximum accuracy was achieved when the number of features was 19. At this point, the specificity was 0.94. It may also be stated that the average accuracy was increased when PCA was applied. Also, the efficacy of the classifier was significantly affected when the number of features was reduced (Initially, there were 67,500 features, which were reduced to 23 and finally to 15, for the first two groups). It may be noted that the higher number of features may reduce the accuracy as some of the features may be noisy. Also, some features do not add accuracy as they may be correlated. The pipeline takes care of the above problems and tries to remove the redundant features.

## 5.2 Use of images data to establish that emotional intelligence plays a role in qualitative market research techniques

This experiment aims to recognise emotions from a given set of pictures. The problem is a classification problem and comes under supervised learning. Since each image has many features, feature extraction techniques are required to reduce the feature set. This research applies PCA for transforming the dimensions of the data. PCA helps in converting the data and improves the efficiency and effectiveness of the classifier. This was followed by the application of FDR to order features. The application of forward feature selection can further reduce the number of features. The suggested model reads a set of images, converts them to a two-dimensional array, followed by the application of PCA. The resultant data is subjected to forward feature selection. This resulted in reducing the dimensionality of the data to a large extent. High values of accuracy, specificity and sensitivity conclude that the proposed machine learning model can help to identify emotions. The data is then given to the SVM classifier.

**Figure 13: Classification of Images data**

The accuracy, specificity and sensitivity are encouraging. The average accuracy is 0.80; specificity is .97 and sensitivity is 0.75. This helps to conclude that this model can detect emotions on facial images by 80% accuracy and will be specific 97% times and sensitive 75% times.

## 5.3 Experiment and observation for feature selection and regression of Text data to find the essential feature out of TMMS test of Emotional Intelligence measurement test

The data collected had 22 features. Not all the features are important. The features were, first selected based on the Fisher Discriminate Ratio. Table 11 shows the FDR of various features, and Table 12, shows the ranking of the features based on the FDR.

The following table (Table 13) shows the rounds of the 10-fold cross-validation using an SVM classifier. The features were again ranked based on the results obtained.

**Table 11: FDRs of the features**

|  |  |
| --- | --- |
| **Serial Number** | **FDR** |
| 1 | 1.37172 |
| 2 | 0.139827 |
| 3 | 0.299433 |
| 4 | 1.026256 |
| 5 | 0.01826 |
| 6 | 0.314402 |
| 7 | 0.11102 |
| 8 | 0.378544 |
| 9 | 0.230846 |
| 10 | 0.73387 |
| 11 | 0.290508 |
| 12 | 0.13533 |
| 13 | 0.358461 |
| 14 | 0.632288 |
| 15 | 3.23953 |
| 16 | 0.029578 |
| 17 | 0.525508 |
| 18 | 0.089468 |
| 19 | 1.549595 |
| 20 | 0.747975 |
| 21 | 1.018191 |
| 22 | 0.750334 |

Table 12 below shows features ranked in the descending order of Fisher Discriminate Ratio

**Table 12: Ranking of the features based on the FDR**

|  |  |
| --- | --- |
| **Feature Number** | **FDR** |
| 15 | 3.239529813 |
| 19 | 1.549594518 |
| 1 | 1.371719776 |
| 4 | 1.026255857 |
| 21 | 1.018191217 |
| 22 | 0.750334146 |
| 20 | 0.747974678 |
| 10 | 0.733870437 |
| 14 | 0.632288229 |
| 17 | 0.525508167 |
| 8 | 0.378544061 |
| 13 | 0.358460672 |
| 6 | 0.314402066 |
| 3 | 0.299433107 |
| 11 | 0.290507635 |
| 9 | 0.230845727 |
| 2 | 0.13982684 |
| 12 | 0.135330027 |
| 7 | 0.111020211 |
| 18 | 0.089467871 |
| 16 | 0.029577793 |
| 5 | 0.018259561 |

**Table 13: Results of the 10-fold cross validation**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 100 | 75 | 50 | 25 | 25 | 75 | 50 | 75 | 75 | 66.67 | 61.667 |
| 66.66667 | 50 | 50 | 50 | 75 | 25 | 75 | 50 | 75 | 100 | 61.667 |
| 66.66667 | 75 | 75 | 50 | 75 | 0 | 50 | 50 | 100 | 66.67 | 60.833 |
| 66.66667 | 50 | 75 | 50 | 50 | 75 | 75 | 50 | 25 | 33.33 | 55 |
| 66.66667 | 50 | 75 | 75 | 50 | 50 | 25 | 75 | 50 | 66.67 | 58.333 |
| 33.33333 | 75 | 100 | 75 | 75 | 100 | 50 | 100 | 75 | 100 | 78.333 |
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 75 | 100 | 66.67 | 94.167 |
| 100 | 75 | 25 | 75 | 50 | 25 | 25 | 50 | 50 | 66.67 | 54.167 |
| 33.33333 | 50 | 50 | 100 | 75 | 100 | 50 | 50 | 50 | 66.67 | 62.5 |
| 66.66667 | 50 | 25 | 75 | 50 | 100 | 50 | 25 | 50 | 100 | 59.167 |
| 66.66667 | 100 | 100 | 100 | 75 | 75 | 100 | 75 | 75 | 66.67 | 83.333 |
| 66.66667 | 75 | 25 | 75 | 75 | 100 | 100 | 100 | 100 | 66.67 | 78.333 |
| 33.33333 | 75 | 50 | 50 | 50 | 100 | 100 | 75 | 100 | 33.33 | 66.667 |
| 66.66667 | 75 | 50 | 25 | 100 | 100 | 50 | 50 | 100 | 66.67 | 68.333 |

**Figure 14: Classification efficiency based on individual features**

**Figure 15: Classification efficiency**

## 5.4 Feature selection to find the essential feature of emotional intelligence

The evaluation of Emotional Intelligence helps the organisation to take corrective actions and hence increase the efficiency and productivity of the employees. However, for large organisations, this evaluation may lead to noisy and incomplete data. The data can be obtained using machine learning methods. However, to apply the machine learning methods, the number of features should be reduced. This study finds the most important features of the test using feature discrimination ratios, as depicted in figure 16. The proposed model employs both wrapper and filter methods to accomplish the task. Moreover, the application of 10-fold and 20-fold validation would facilitate the identification of features which appear important in each iteration. If the commutative methods are used, then the first seven features calculated according to the FDR are the most important. The first sixteen features constitute 96% of the commutative FDR and rest are not important as per the machine learning methods. Note that, the application of Neural Networks also brought the fact that 7 out of the 22 features are sufficient to describe the problem as a classification one completely. This helps in the measurement of EI by finding the most important features of the TMMS test of EI using Machine Learning techniques. It is intended to carry out similar experiments in the future for the remaining tests used for measuring EI, and hence to develop a better model for understanding, classifying and predicting EI.

In order to measure EI, issues like the handling of noise and regression need to be addressed. This study suggests a framework to do the same using regression analysis. In the data obtained by the EI tools, this process can be used to find the missing data and hence contribute to the better and effective assessment. This would lead to pointed and effective corrective measures to handle the workforce. The process can be carried out using statistical methods, but in the case of large data, the methods would not be efficient. This work applies ML methods to accomplish the said task, and a neural network has been used to carry out the regression. The model has been implemented and has been tested with the data collected. The experiment has been repeated 100 times, and the results suggest that the technique is not only effective but is also efficient as compared to the conventional methods.

****

**Figure 16: Feature Selection using Feature Discrimination Ratio**

## 5.5 Regression to find missing data out of Emotional Intelligence measurement test

The purpose of this experiment was to find out the unknown data in a given sample of TMMS data. The process was carried out by training a NN by data collected from 138 subjects. The data had 22 fields, and the target data is the total TMMS data scored. It may be noted that the TMMS score is calculated by giving +1 weight to some of the fields and reverse to the others. 70% of the data was used for training model, and 15% for validation. The validation data helps in making a better model in the process of training. The test data is used to ascertain the model. The test data is not seen by the model and hence the results obtained by the test data establish the correctness of the proposed model. In our model, 15% of the data was used for testing. The number of hidden neurons in the model was 10. The proposed work has been depicted in Figure 17.

**Figure 17: Regression Using Neural Networks**

The data was collected by choosing 138 persons having age between 25 and 35. The sample chosen was representative of the population. Moreover, the mean age of the population was 31, and the standard deviation of the ages was 4.6. Utmost care was taken in gathering the data and analysing it. The mean of the final score was 43.34, and the standard deviation of 8.811. In our study, 138 subjects were considered. In our work, we use both total and partial score to predict the classification.

The data was pre-processed and then subjected to the experiment. First of all, missing values were filled as follows. If for a particular person, the majority of the fields were incomplete; his data was not taken as the training example of the model. In other cases, regression analysis was applied to fill the unknown values. The data was then normalized by calculating the z score

$z=\frac{x-m}{s}$,

Where x is the value, m is the mean and s is the standard deviation. However, later it was realized that the normalization did not have any effect on the results. The data collected had 22 features.

It may be stated that in this study, since the number of samples is limited, and the current experiment does not deal with the imaging data, Deep Learning cannot be used. From amongst the available options, various models were tried. Initially, regression was carried out using the support vector machine, neural network and random forest in Matlab. Twenty experiments were carried out with the default parameters. It was observed that the neural networks gave the best results, perhaps due to the non-linear nature of the data. The next task was to vary the learning algorithm and the number of neurons in the hidden layer of a shallow network to find the optimal results. The nnstart tool’s FittingApp has been used to carry out the said task. The samples are taken as the matrix columns. The division of the data has been done as follows

* Training: 70%
* Testing: 15%
* Validation: 15%

The training algorithm and the number of neurons in the hidden layer have been varied. The experiment was repeated ten times. The results are reported in Table 14.

 It may be noted that the best performance is obtained when the number of neurons in the hidden layer is 10, and the training algorithm is Bayesian Regularization. However, in this case, the epoch is 224. It may also be stated that using the Levenberg Marquardt learning, the best result obtained is 5.80584, when The epoch is just 4. The performance has been shown in figures 18 to 27.

1. Input Data:

Data: Matrix $n×22$

Data = Data’

Target: Matrix $n×1$

Target = Target’

1. nnstart ->FittingApp -> Select Data

 Samples are matrix columns

1. Division
	1. Training: 70%
	2. Testing: 15%
	3. Validation: 15%
2. Number of neurons in hidden layers: 10
3. Training Algorithm: Levenberg Marquardt

**Table 14: Performance enhancement by varying the training algorithm and the number of Neurons**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No.** | **Number of Neurons** | **Training Algorithm** | **epoch** | **Best performance** |
| 1 | 10 | Levenberg Marquardt | 3 | 25.7718 |
| 2 | 8 | Levenberg Marquardt | 2 | 8.7809 |
| 3 | 6 | Levenberg Marquardt | 4 | 5.80584 |
| 4 | 5 | Levenberg Marquardt | 4 | 13.7624 |
| 5 | 3 | Levenberg Marquardt | 5 | 23.068 |
| **6** | **10** | **Bayesian Regularization** | **224** | **3.7e-17** |
| 7 | 8 | Bayesian Regularization | 369 | 1.9e-16 |
| 8 | 6 | Bayesian Regularization | 714 | 3.19e-18 |
| 9 | 5 | Bayesian Regularization | 422 | 1.7e-16 |
| 10 | 3 | Bayesian Regularization | 357 | 1.5e-15 |



**Figure 18: Levenberg Marquardt training Algorithm with 10 neurons and epoch=3**

1. Input Data:

Data: Matrix $n×22$

Data = Data’

Target: Matrix $n×1$

Target = Target’

1. nnstart ->FittingApp -> Select Data

Samples are matrix columns

1. Division
	1. Training: 70%
	2. Testing: 15%
	3. Validation: 15%
2. Number of neurons in hidden layers: 8
3. Training Algorithm: Levenberg Marquardt

****

**Figure 19: Levenberg Marquardt training Algorithm with 8 neurons and epoch=2**

1. Input Data:

Data: Matrix $n×22$

Data = Data’

Target: Matrix $n×1$

Target = Target’

1. nnstart ->FittingApp -> Select Data

Samples are matrix columns

1. Division
2. Training: 70%
3. Testing: 15%
4. Validation: 15%
5. Number of neurons in hidden layers: 6
6. Training Algorithm: Levenberg Marquardt

****

**Figure 20: Levenberg Marquardt training Algorithm with 6 neurons and epoch = 4**

1. Input Data:

Data: Matrix $n×22$

Data = Data’

Target: Matrix $n×1$

Target = Target’

1. nnstart ->FittingApp -> Select Data

 Samples are matrix columns

1. Division
2. Training: 70%
3. Testing: 15%
4. Validation: 15%
5. Number of neurons in hidden layers: 5
6. Training Algorithm: Levenberg Marquardt

****

**Figure 21: Levenberg Marquardt training Algorithm with 5 neurons and epoch = 4**

1. Input Data:

Data: Matrix $n×22$

Data = Data’

Target: Matrix $n×1$

Target = Target’

1. nnstart ->FittingApp -> Select Data

 Samples are matrix columns

1. Division
2. Training: 70%
3. Testing: 15%
4. Validation: 15%
5. Number of neurons in hidden layers: 3
6. Training Algorithm: Levenberg Marquardt

****

**Figure 22: Levenberg Marquardt training Algorithm with 3 neurons and epoch =5**

1. Input Data:

Data: Matrix $n×22$

Data = Data’

Target: Matrix $n×1$

Target = Target’

1. nnstart ->FittingApp -> Select Data

 Samples are matrix columns

1. Division
2. Training: 70%
3. Testing: 15%
4. Validation: 15%
5. Number of neurons in hidden layers: 10
6. Training Algorithm: Bayesian Regularization

****

**Figure 23: Bayesian Regularization training Algorithm with 10 neurons and epoch = 224**

1. Input Data:

Data: Matrix $n×22$

Data = Data’

Target: Matrix $n×1$

Target = Target’

1. nnstart ->FittingApp -> Select Data

 Samples are matrix columns

1. Division
2. Training: 70%
3. Testing: 15%
4. Validation: 15%
5. Number of neurons in hidden layers: 8
6. Training Algorithm: Bayesian Regularization

****

**Figure 24: Bayesian Regularization training Algorithm with 8 neurons and epoch = 369**

1. Input Data:

Data: Matrix $n×22$

Data = Data’

Target: Matrix $n×1$

Target = Target’

1. nnstart ->FittingApp -> Select Data

 Samples are matrix columns

1. Division
2. Training: 70%
3. Testing: 15%
4. Validation: 15%
5. Number of neurons in hidden layers: 6
6. Training Algorithm: Bayesian Regularization

****

**Figure 25: Bayesian Regularization training Algorithm with 6 neurons and epoch = 714**

1. Input Data:

Data: Matrix $n×22$

Data = Data’

Target: Matrix $n×1$

Target = Target’

1. nnstart ->FittingApp -> Select Data

 Samples are matrix columns

1. Division
2. Training: 70%
3. Testing: 15%
4. Validation: 15%
5. Number of neurons in hidden layers: 5
6. Training Algorithm: Bayesian Regularization

****

**Figure 26: Bayesian Regularization training Algorithm with 5 neurons and epoch = 422**

1. Input Data:

Data: Matrix $n×22$

Data = Data’

Target: Matrix $n×1$

Target = Target’

1. nnstart ->FittingApp -> Select Data

 Samples are matrix columns

1. Division
2. Training: 70%
3. Testing: 15%
4. Validation: 15%
5. Number of neurons in hidden layers: 3
6. Training Algorithm: Bayesian Regularization

****

**Figure 27: Bayesian Regularization training Algorithm with 3 neurons and epoch = 357**

# CHAPTER 6

# CONCLUSION AND CONTRIBUTION OF THE STUDY

The study conducted an extensive literature review to find the gaps in the existing literature. The study has identified the most important features of the common test used for measuring Emotional Intelligence. It has proposed a framework to identify the missing data in the tests mentioned above. The work establishes the fact that the combination of filter methods like Feature Discrimination Ratio and forward feature selection can reduce the number of features of an EI measurement test to a large extent.

The study created a framework to classify the faces based on emotions. It may be concluded that artificial intelligence can help in increased emotional intelligence and gather customer intelligence. In a nutshell, it can be said that Emotional Intelligence plays a role in qualitative market research techniques, as reported. So there are a significant relationship in Emotional Intelligence and qualitative market research techniques. It is also concluded that missing data while measuring EI can be predicted using regression techniques. It is also concluded that features of the existing EI test can be ranked according to their importance to get the most important features. The emotions on faces can be detected using machine learning, and that can help in study consumer behaviour as behaviour comprises of emotions, thus increasing the impact of qualitative market research techniques as depicted in figure 28.

**Figure 28: Conclusion**

#

# CHAPTER 7

# RECOMMENDED STRATEGIES FOR THE MEASUREMENT OF EMOTIONAL INTELLIGENCE

Literature has brought some strategies that organisations can adopt to use EI for the betterment of the workforce. The above strategies would be beneficial if there is a way to measure EI. This work recommends the following

* 1. In the case of a large number of candidates in an organisation, Emotional Intelligence can be measured with the help of Machine Learning techniques.
	2. Measuring Emotional Intelligence can be easier if the number of features can be reduced.
	3. Market research companies should use Facial images data for studying consumer behaviour
	4. Market research companies should train their employees in Emotional Intelligence.
	5. Machine learning methods should be used by Market research companies to study consumer behaviour.
	6. Facial images data should be analysed for generating customer intelligence.

# CHAPTER 8

# IMPLICATIONS OF THE STUDY

##

## 8.1 Industry

This study will help companies recruiting especially software/IT organisations in measuring EI of their existing and prospective employees as this study solve the problems encountered during measurement. It may be noted that a big IT organisation like Infosys recruit around 30,000 candidates in India for the entry-level position from a pool of around half a million applicants every year. These tests are conducted in universities and colleges with limited computing resources for a large number of candidates. The data collected for testing emotional intelligence will be huge, and it becomes tough to include a test to measure Emotional Intelligence in the recruitment process. The framework proposed in this paper reduces the need for computing resources.

In the qualitative market research industry, an audio-visual recording is ubiquitous, and the framework suggested in this study can be used to analyse the faces of respondents and can predict the emotions active on the face of the respondent at that time. In qualitative market research, some stimuli are used, and the researcher needs to know the emotional reaction to that stimuli. Questions like how the audience reacted, in an in-depth interview, after watching the advertisement, can be answered with the framework suggested in this study. This can assist companies in creating successful advertisements and optimising their digital media content. For example, what is an emotional response on the face of children by looking at the packaging of chocolate can be great information for brand managers of companies like Nestle. In car clinics, a market research technique used for comparison of new cars, emotions on the faces of respondents can help in the prediction of the success rate of the car.

## 8.2 Academia

This study improves the use of Trait Meta Mood scale, which is one of the widely used instruments for measuring Emotional Intelligence. This study gives ideas for future research in the area of machine learning in emotional intelligence for various applications in market research techniques. This study fills the gap in the literature.

#

# CHAPTER 9

# LIMITATION AND FUTURE SCOPE OF THE STUDY

The shortage of research papers in the context of Applicability of Machine Learning in Emotional Intelligence is the prime limitation of the study. This study is limited to a few qualitative market research techniques, and researchers are using more and more techniques. The future studies may research on the newer techniques.

Emotions have been recognized by using publicly available data. Because of the diversified culture, the automation of detection of emotions would require multiple datasets from diverse sources. Scope of the study is limited to finding the essential features of the data and the detection of emotions from the pictures. In future work, a larger dataset consisting of images and videos can be used instead of images. Future scope of the study is immense as the quantification of emotions and detection would help the organizations, and this impact can also be found over the years. Similar studies can be conducted in different industries to attain more insights about the impact of emotional intelligence on the output.

# REFERENCES

1. Abbey, A., & Andrews, F. M. (1985). Modelling the psychological determinants of life quality. *Social Indicators Research*, 16(1), 1-34.
2. Alpaydin, E. (2014). *Introduction to Machine Learning*. MIT Press.
3. Anderson, J.A. (1995). *An Introduction to Neural Networks*. MIT Press.
4. Andreas, D. F. (2014). *Deferred Pay, Mergers and Acquisitions and Sectoral Deflation, Frame Deconstructions: Emails from 2011 through 2013.* Xlibris
5. Awwad, M. S., & Ali, H. K. (2012). Emotional intelligence and entrepreneurial orientation: The moderating role of organizational climate and employees' creativity. *Journal of Research in Marketing and Entrepreneurship*, 14(1), 115-136.
6. Bar-On, R. (1997). The Bar-On Emotional Quotient Inventory (EQ-i): *Technical manual. Multi-Health Systems*. Toronto, Canada.
7. Bar-On, R. (2004). The Bar-On Emotional Quotient Inventory (EQ-i): Rationale, description and psychometric properties. In G. Geher (Ed.), *Measuring emotional intelligence: Common ground and controversy. Nova Science*, Hauppauge, NY, 111-142.
8. Bass, B. M., & Avolio, B. J. (1990). *Transformational leadership development: Manual for the multifactor leadership questionnaire*. Consulting Psychologists Press.
9. Bayani, A. A. (2009). Psychometric data for a Farsi translation of the Trait Meta-Mood Scale. *Psychological Reports*, 105(1), 198-204.
10. Beigi, M., & Shirmohammadi, M. (2011). Effects of an emotional intelligence training program on service quality of bank branches. *Managing Service Quality: An International Journal*, 21(5), 552-567.
11. Belaise, C., Fava, G. A., & Marks, I. M. (2005). Alternatives to debriefing and modifications to cognitive behavior therapy for posttraumatic stress disorder. *Psychotherapy and Psychosomatics*, 74(4), 212-217.
12. Belbin, R. (1993). A reply to the Belbin Team-Role Self-Perception Inventory by Furnham, Steele and Pendleton. *Journal of Occupational and Organizational Psychology*, 66(3), 259-260.
13. Bevan, D., Kipka, C., & Bartsch, G. (2012). Emotional learning: managerial development by corporate volunteering. *Journal of Management Development*, 31(3), 253-262.
14. Bishop, C. M. (2006). Pattern Recognition and Machine Learning. Springer.
15. Boyatzis, R. E, & Burckle M (1999). Psychometric properties of the ECI: Technical Note. *The Hay/McBer Group, Boston*.
16. Boyatzis, R. E., Goleman, D., & Rhee, K. (2000). Clustering competence in emotional intelligence: Insights from the Emotional Competence Inventory (ECI). *Handbook of emotional intelligence*, Jossey-Bass, San Francisco, *99*(6), 343-362.
17. Boyatzis, R. E., & Soler, C. (2012). Vision, leadership and emotional intelligence transforming family business*. Journal of Family Business Management*, 2(1), 23-30.
18. Brackett, M. A., Mayer, J. D., & Warner, R. M. (2004). Emotional intelligence and its relation to everyday behaviour. *Personality & Individual Differences*, 36(6), 1387–1402.
19. Cattell, H. E., & Schuerger, J. M. (2003). *Essentials of 16PF assessment* (Vol. 45). John Wiley & Sons.
20. Cha, W. L. (2011). Machine Learning Tutorial, *Digital Image and Signal Processing*. 1st Ed. Graduate Institute of Communication Engineering, NTU.
21. Collins, C. S., & Cooper, J. E. (2014). Emotional intelligence and the qualitative researcher. *International Journal of Qualitative Methods*, *13*(1), 88-103.
22. Ciarrochi, J., Chan, A. Y., & Bajgar, J. (2001). Measuring emotional intelligence in adolescents. *Personality and individual differences*, *31*(7), 1105-1119.
23. Coccaro, E. F., Berman, M. E., & Kavoussi, R. J. (1997). Assessment of life history of aggression: development and psychometric characteristics. *Psychiatry Research*, *73*(3), 147-157.
24. Coccaro, E. F., & Jacobson, K. C. (2006). Penn Twins: a population-based cohort for twin studies. *Twin research and human genetics: the official journal of the International Society for Twin Studies*, 9(6), 998–1005.
25. Coccaro, E. F., Lee, R., & McCloskey, M. S. (2014). Relationship between psychopathy, aggression, anger, impulsivity, and intermittent explosive disorder. *Aggressive Behavior*, *40*(6), 526-536.
26. Coccaro, E. F., & Schmidt-Kaplan, C. A. (2012). Life history of impulsive behaviour: development and validation of a new questionnaire. *Journal of Psychiatry Research*, 46(3), 346–352.
27. Coccaro, E. F., Solis, O., Fanning, J., & Lee, R. (2015). Emotional intelligence and impulsive aggression in intermittent explosive disorder. *Journal of Psychiatry Research*, 61, 135–140.
28. Cooper, R. K., & Sawaf, A. (1998). Executive EQ: *Emotional intelligence in leadership and organizations*. Penguin.
29. Daelemans, W., & Morik, K. (Eds.). (2008). *Machine Learning and Knowledge Discovery in Databases: European Conference, Antwerp, Belgium, September 15-19, 2008, Proceedings*, 5212. Springer.
30. Nayak, J., Vakula, K., Dinesh, P., & Naik, B. (2020). Moth Flame Optimization: Developments and Challenges up to 2020. In *Computational Intelligence in Pattern Recognition*, 465-488. Springer, Singapore.
31. Davies, M., Stankov, L., & Roberts, R. D. (1998). Emotional intelligence: in search of an elusive construct. *Journal of Personality and Social Psychology*, 75(4), 989–1015.
32. Druskat, V. U., & Wolff, S. B. (2001). Group emotional intelligence and its influence on group effectiveness. *The emotionally intelligent workplace: How to select for, measure, and improve emotional intelligence in individuals, groups and organizations*, 132-155.
33. Duda, R. O., Hart, P. E., & Stork, D. G. (2012). *Pattern classification*. John Wiley & Sons.

1. [Dulewicz](http://www.emeraldinsight.com/author/Dulewicz%2C%2BVictor), V, & [Higgs](http://www.emeraldinsight.com/author/Higgs%2C%2BMalcolm), M (2000). [Emotional intelligence](http://www.emeraldinsight.com/doi/abs/10.1108/02683940010330993) – [A review and evaluation study](http://www.emeraldinsight.com/doi/abs/10.1108/02683940010330993). [*Journal of Managerial Psychology*](http://www.emeraldinsight.com/doi/abs/10.1108/02683940010330993), 15(4), 341-372.
2. Ebesutani, C., Smith, A., Bernstein, A., Chorpita, B. F., Higa-McMillan, C., & Nakamura, B. (2011). A bifactor model of negative affectivity: Fear and distress components among younger and older youth. *Psychological assessment*, *23*(3), 679.
3. Ekman, P. (1973). Cross-cultural studies of facial expression. *Darwin and facial expression: A century of research in review*, *169222*(1). Academic Press. New York.
4. Ekman, P., & Friesen, W. V. (1971). Constants across culture in the face and emotion*. Journal of Personality and Social Psychology*, 17(2), 124-129.
5. Ekman, P., & Oster, H. (1979). Facial expressions of emotion. *Annual review of psychology*, *30*(1), 527-554.
6. Emmerling, R., Boyatzis, R. E., & Emmerling, R. J. (2012). Emotional and social intelligence competencies: cross cultural implications. *Cross Cultural Management: An International Journal,* 19(1), 4-18
7. Erkutlu, H., & Chafra, J. (2012). The impact of team empowerment on proactivity: The moderating roles of leader's emotional intelligence and proactive personality. *Journal of Health Organisation and Management*, 26, 560 - 577.
8. Berrocal, P., & Extremera, N. (2008). A review of trait meta-mood research. *Advanced Psychology Research*, 55, 17-45.
9. Fleenor, J., & Sheehan, E. (2007). Review of the multifactor leadership questionnaire. *The Seventeenth mental measurement yearbook*.
10. Gabel, S. R., & Dolan, S. (2011). Do emotions matter?: The role of emotional intelligence competencies in cross-cultural adjustment for international assignment. *Management Research: The Journal of the Iberoamerican Academy of Management*, 9(3), 207-229.
11. Garbas, J. U., Ruf, T., Unfried, M., & Dieckmann, A. (2013). Towards robust real-time valence recognition from facial expressions for market research applications. In *2013 Humaine Association Conference on Affective Computing and Intelligent Interaction*. IEEE, 570-575.
12. Ghuman, U. (2011). Building a model of group emotional intelligence. *Team Performance Management: An International Journal*, 17(7/8), 418-439.
13. Gignac, G. E., Harmer, R. J., Jennings, S., & Palmer, B. R. (2012). EI training and sales performance during a corporate merger. *Cross Cultural Management*, *19*(1), 104.
14. Gignac, G. E. (2006). Self-reported emotional intelligence and life satisfaction: Testing incremental predictive validity hypotheses via structural equation modelling (SEM) in a small sample. *Personality and Individual Differences*, 40(8), 1569-1577.
15. Goleman, D. (1998). *Working with emotional intelligence*. Bantam.
16. Gowing, M. K. (2001). Measurement of individual emotional competence. *The emotionally intelligent workplace: How to select for, measure, and improve emotional intelligence in individuals, groups, and organizations*, 83-131.
17. Grubb III, W. L., & McDaniel, M. A. (2007). The fakability of Bar-On's emotional quotient inventory short form: Catch me if you can. *Human Performance*, *20*(1), 43-59.
18. Hamme, C. (2003). Group emotional intelligence: the research and development of an assessment instrument a dissertation submitted to the faculty. Rutgers University, New Brunswick, NJ *Doctoral Dissertation*.
19. Haykin, S. (2008). Neural Networks and Learning Machines, edit Prentice Hall. New Jersey, *USA*.
20. Holkamp, Y. H. (2014). Classification of valence using facial expressions of TV-viewers. *Thesis Delft University of Technology*. Delft, The Netherlands.
21. Hong, Y., Catano, V. M., & Liao, H. (2011). Leader emergence: The role of emotional intelligence and motivation to lead. *Leadership & Organization Development Journal,* 32(4), 320-343.
22. https://www.iis.fraunhofer.de/en/ff.html. Accessed 26 January 2018.
23. Jones, T. L., & Argentino, D. (2010). Nurse-to-nurse hostility, confrontational anxiety, and emotional intelligence: An integral, descriptive pilot study. *Journal of PeriAnesthesia Nursing*, 25(4), 233-241.
24. Jordan, P. J., & Troth, A. (2011). Emotional intelligence and leader member exchange. *Leadership and Organizational Development Journal*, 38, 260 – 280
25. Keefer, K., Parker, J., & Saklofske, D. (2018). Emotional Intelligence in Education. *Integrating Research with Practice*. Springer, Cham, Switzerland.
26. Kibbe, M. R., & Chen, H. (Eds.). (2015). Leadership in surgery. Springer International Publishing, Cham, Switzerland.
27. Kithenham, B. A. (2012). Systematic review in software engineering: where we are and where we should be going. *Proceedings of the 2nd international workshop on evidential assessment of software technologies*, Association for Computing Machinery, 1-2.
28. Lam, C. S., & O'Higgins, E. R. (2012). Enhancing employee outcomes: The interrelated influences of managers' emotional intelligence and leadership style. *Leadership and Organization Development Journal*, 33(2), 149-174.
29. Landwehr, J. R., McGill, A. L., & Herrmann, A. (2011). It's got the look: The effect of friendly and aggressive “facial” expressions on product liking and sales. *Journal of Marketing*, 75(3), 132-146.
30. Laurent, J., Catanzaro, S. J., Joiner Jr, T. E., Rudolph, K. D., Potter, K. I., Lambert, S., ... & Gathright, T. (1999). A measure of positive and negative affect for children: scale development and preliminary validation. *Psychological assessment*, 11(3), 326.
31. Law, K. S., Wong, C. S., & Song, L. J. (2004). The construct and criterion validity of emotional intelligence and its potential utility for management studies***.****Journal of Applied Psychology*, 89(3), 483-496.
32. Lee, S. (2017). *Quantitative Analysis of Human Facial Expression*: *Moving Towards the Creation of a Virtual Patient*. Doctoral dissertation, University of California, Los Angeles.
33. Love, P., Edwards, D., & Wood, E. (2011). Loosening the Gordian knot: the role of emotional intelligence in construction*. Engineering, Construction and Architectural Management*, 18(1), 50-65.
34. Lu, D., Kiewit, D. A., & Zhang, J. (1994). *U.S. Patent No. 5,331,544*. Washington, DC: U.S. Patent and Trademark Office.
35. Marketing, R., & Giesler, M. (2010). Definitions of Marketing.
36. Matthews, G., Zeidner, M., & Roberts, R. D. (2004). *Emotional intelligence: Science and myth*. MIT press.
37. Mayer, J. D., Gaschke, Y. N. (1988). The experience and meta-experience of mood. *Journal of personality and social psychology*, 55(1), 102.
38. Mayer, J. D., Salovey, P., & Caruso, D. R. (2002). Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT). *Multi-Health Systems Inc*, Toronto, Ontario.
39. Mayer, J. D., Salovey, P., Salovey, P., & Sluyter, D. (1997). Emotional development and emotional intelligence: Implications for educators. *What is emotional intelligence*, *5*.
40. Mayer, J. D., Salovey, P., & Caruso, D. R. (2004). Emotional intelligence: Theory, findings, and implications. *Psychological Inquiry*, 15(3), 197-215.
41. Mayer, J. D., Salovey, P., Caruso, D. R., & Sitarenios, G. (2003). Measuring emotional intelligence with the MSCEIT V2.0. *Emotion*, 3(1), 97-105.
42. McCulloch, W. S., & Pitts, W. (1943). A logical calculus of the ideas immanent in nervous activity. *Bulletin of Mathematics Biophysics*, 5(4), 115-133.
43. Mikolajczak, M., Luminet, O., Leroy, C., & Roy, E. (2007). Psychometric properties of the Trait Emotional Intelligence Questionnaire: Factor structure, reliability, construct, and incremental validity in a French-speaking population. *Journal of personality assessment*, 88(3), 338-353.
44. Mitchell, T. M. (1980). *The need for biases in learning generalizations*. Department of Computer Science, Laboratory for Computer Science Research, Rutgers University, New Jersey. 184 -191.
45. Myers, I. B., & Myers, P. (1995). Gifts Differing: Understanding Personality Type: Davies.
46. [Nelson](https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Darwin+B.+Nelson%22), D. B., & [Low](https://www.google.co.in/search?tbo=p&tbm=bks&q=inauthor:%22Gary+R.+Low%22), G. R. (2011). *Emotional Intelligence: Achieving Academic and Career Excellence in college and in life*. 2nd Ed., Prentice-Hall, Boston, MA.
47. Nicolaidis, C., & Katsaros, K. (2011). Tolerance of ambiguity and emotional attitudes in a changing business environment: *A case of Greek IT CEOs, Journal of Strategy and Management*, 4(1), 44-61.
48. Ohme, R., Reykowska, D., Wiener, D., & Choromanska, A. (2009). Analysis of neurophysiological reactions to advertising stimuli by means of EEG and galvanic skin response measures. *Journal of Neuroscience, Psychology, and Economics*, 2(1), 21-31.
49. Padhy, N. P., & Simon, S. P. (2015). *Soft computing: with MATLAB programming*. Oxford University Press, Inc.
50. Peláez-Fernández, M. A., Extremera, N, & Fernández-Berrocal, P. (2014). Perceived emotional intelligence and aggression among adults: the moderating role of gender. *Australian Joural of Psychology*, 67(3), 140–148.
51. Petrides, K. V. (2011). Ability and trait emotional intelligence. In T. Chamorro Premuzic, A. Furnham, & S. von Stumm (Eds.), *The Wiley-Blackwell handbook of individual differences*, 1st ed., New York: Wiley, 656–678.
52. Petrides, K. V. (2009). Psychometric properties of the trait emotional intelligence questionnaire (TEIQue). In *Assessing emotional intelligence* (pp. 85-101). Springer, Boston, MA.
53. Petrides, K. V, & Furnham, A. (2003). Trait emotional intelligence: Behavioural validation in two studies of emotion recognition and reactivity to mood induction. *European Journal of Personality*, 17(1), 39–57.
54. Petrides, K. V, & Furnham, A. (2006). The role of trait emotional intelligence in a gender-specific model of organizational variables. *Journal of Applied Social Psychology*, 36(2), 552–569.
55. [Poels](https://papers.ssrn.com/sol3/cf_dev/AbsByAuth.cfm?per_id=563238), K., & [Dewitte](https://papers.ssrn.com/sol3/cf_dev/AbsByAuth.cfm?per_id=709365), S. (2006). How to Capture the Heart? Reviewing 20 Years of Emotion Measurement in Advertising: *Journal of Advertising Research*, 46, 18-37.
56. Posner, B. Z., and Kouzes, J. M. (1988). Development and validation of the Leadership Practices Inventory. *Educational and Psychological Measurement*, 1988, 48(2), 483-496.
57. Rojas, R. (2013). *Neural networks: a systematic introduction*. Springer Science & Business Media.
58. Ryan, G., Spencer, L. M., & Bernhard, U. (2012). Development and validation of a customized competency-based questionnaire*. Cross Cultural Management: An International Journal,* 19(1), 90-103.
59. Salovey, P., & Mayer, J. D. (1990). Emotional intelligence. *Imagination, cognition and personality*, 9(3), 185-211.
60. Salovey, P., Mayer, J. D., Goldman, S. L., Turvey, C., & Palfai, T. P. (1995). Emotional attention, clarity, and repair: Exploring emotional intelligence using the Trait Meta-Mood Scale. In J. W. Pennebaker (Ed.), Emotion, disclosure, & health (p. 125–154). American Psychological Association.
61. Schutte, N. S, Hall, L. E., Haggerty, D. J., Cooper, J. T., Golden, C. J., & Dornheim, L. (1998). Development and validation of a measure of emotional intelligence. *Personality and individual differences*, *25*, 167-177.
62. Sebe, N., Lew, M. S., Sun, Y., Cohen, I., Gevers, T., & Huang, T. S. (2007). Authentic facial expression analysis. *Image and Vision Computing*, 25(12), 1856-1863.
63. Siegling, A. B., Saklofske, D. H., & Petrides, K. V. (2015). Measures of ability and trait emotional intelligence. *Measures of personality and social psychological constructs*, (381-414). Academic Press.
64. Smithson, M., & Verkuilen, J. (2006). A better lemon squeezer? Maximum-likelihood regression with beta-distributed dependent variables. *Psychological methods*, 11(1), 54.
65. Sharma, M., Khera, S. N., & Sharma, P. B. (2019). Applicability of Machine Learning in the Measurement of Emotional Intelligence. *Annals of Data Science*, 6(1), 179-187.
66. Sharma, M., Khera, S. N., & Sharma, P. B. (2019). The troika of artificial intelligence, emotional intelligence and customer intelligence. *International Journal of Social Computing and Cyber-Physical Systems*, 2(2), 119-131.
67. Stys, Y., Brown, & Shelley, L. (2004). *A review of the Emotional Intelligence Literature and implications for corrections*. Research Branch, Correctional Service of Canada.
68. Tapia, M. (2001). Measuring emotional intelligence. *Psychological Reports*, *88*(2), 353-364.
69. Tsochantaridis, I., Joachims, T., Hofmann, T., & Altun, Y. (2005). Large margin methods for structured and interdependent output variables. *Journal of machine learning research*, *6*, 1453-1484.
70. Unfried, M., & Iwanczok, M. (2016). *Improving signal detection in software-based facial expression analysis* (No. 1). GfK Verein Working Paper Series.
71. Vuori, T., & Virtaharju, J. (2012). On the role of emotional arousal in sense giving. *Journal of Organizational Change Management*, 25(1), 48-66.
72. Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of personality and social psychology*, *54*(6), 1063.
73. Wechsler, D. (1999). Wechsler Abbreviated Scale of Intelligence (WASI). SanAntonio, TX: Harcourt Assessment.
74. Wei, H., & Li, S. (2011). Confucian nurturing doctrine of xin (heart-mind): Its enlightenment to organization research. *The Journal of Management Development*, *30*(7-8), 753-765.
75. Weinberg, P., & Konert, F. J. (1984). Emotional facial expressions in advertising. *ACR North American Advances*, 607-611.
76. Wikipedia, Regression Analysis, https://en.wikipedia.org/ wiki/Regression\_analysis accessed on 26th January 2020.
77. Williams, G. J., & Simoff, S. J. (Eds.). (2006). *Data mining: Theory, methodology, techniques, and applications* (Vol. 3755). Springer.
78. Wolff, S. B. (2005). Emotional Competence Inventory (ECI): Technical Manual. Hay Group. *McClelland Center for Research and Innovation.*
79. Wolff, S. B., Pescosolido, A. T., & Druskat, V. U. (2002). Emotional intelligence as the basis of leadership emergence in self-managing teams. *The Leadership Quarterly*, *13*(5), 505-522.
80. Wong, C. S, Law, K. S., & Wong, P. M. (2004). Development and validation of a forced choice emotional intelligence for Chinese respondents in Hong Kong. *Asia Pacific Journal of Management*, 21(4), 535-559.
81. Wong, C. S., & Law [K. S](http://www.bschool.cuhk.edu.hk/index.php/faculty-staff/show-alltest). (2002). The effects of leader and follower emotional intelligence on performance and attitude: An exploratory study. *The Leadership Quarterly,* 13(3), 243-274.
82. Wong, C.S, Wong, P.M., & Law, K. S. (2007). Evidence on the practical utility of Wong's emotional intelligence scale in Hong Kong and Mainland China. *Asia Pacific Journal of Management*, 24, 43-60.
83. Xiaqi, D., Kun, T., Chongsen, Y., & Sufang, G. (2012). Abusive supervision and LMX. *Chinese Management Studies*, 6(2), 257-270.
84. Beck, M., & Libert, B. (2017). The rise of AI makes emotional intelligence more important. *Harvard Business Review*, *15*.
85. Zureda, J. M. (1996). Introduction to Artificial Neural System. West Publishing Company.

# APPENDIX A

Items and Subscale Cronbach's Alphas:

Trait Meta-Mood Scale and Revised Life Orientation Test

Attention to Feelings (alpha = .73)

1. Think\_about\_feelings: I often think about my feelings.

2. Thing\_about\_feelings\_rev: It is usually a waste of time to think about your feelings. (Reversed)

3. Succumbing\_to\_feelings: I believe you should do whatever your feelings tell you to do.

4. Attention\_to\_feelings: I pay a lot of attention to how I feel.

5. Go\_ahed\_with\_feelings: The best way to handle my feelings is just to go ahead and feel whatever I am feeling.

6. Go\_ahead\_feelings\_good: I believe it is good for you to go ahead and feel whatever you feel.

7. Feelings\_for\_decision: My feelings help me decide how to act.

Clarity of Feelings (alpha = .58)

1. Clarity\_almost: I almost always know how I am feeling.

2. Clarity\_usaal: I usually know how I feel about things.

3. Comfortable\_feelings: I am comfortable with my feelings.

4. Clarity\_certain: I am usually very clear about my feelings (I usually know which feeling I am having).

5. Confused\_feelings: I am usually confused about how I feel. (Reversed)

Mood Repair (alpha = .76)

1. try\_calm: If I find myself getting mad, I try to calm myself down.

2. try\_good\_feelings: I try to think about good things no matter how bad I feel.

3. try\_good\_when\_upset: When I become upset, I think about all of the good things in my life.

4. try\_good\_when\_feel\_bad: No matter how bad I feel, I try to think about good things.

Life Orientation Test: Dispositional Optimism (alpha = .60)

1. Fear\_bad: Even though I am sometimes happy, I mostly think bad things are going to happen to me. (Reversed)

2. Realize\_silly\_wories: When I am happy, I realize how silly most of my worries are.

3. Think\_good: Even though I am sometimes sad, I usually think good things will happen to me.

4. Think\_bad: When I am sad, I cannot help thinking about bad things. (Reversed)

5. Think\_not\_so\_good: When I am upset, I realize that the good things in my life are not really good after all. (Reversed)

6. Thnk\_about\_bad: When I am in a bad mood, I think lots of bad things will happen to me. (Reversed)