A Study on the Relationship between Personality Type, Sense of Humor and Creativity

by

Holly C. Greenberg

Submitted to the Department of Mechanical Engineering
in partial fulfillment of the requirements for the degree of

Bachelor of Science in Mechanical Engineering

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 2008

Author .....
Department of Mechanical Engineering
May 9, 2008

Certified by .....
Maria C. Yang
Associate Professor of Mechanical Engineering & Engineering Systems
Thesis Supervisor

Accepted by .....
John H. Lienhard V
Professor of Mechanical Engineering
Chairman, Undergraduate Thesis Committee

A Study on the Relationship between Personality Type, Sense of Humor and Creativity

by

Holly C. Greenberg

Submitted to the Department of Mechanical Engineering
on May 9, 2008, in partial fulfillment of the
requirements for the degree of
Bachelor of Science in Mechanical Engineering

Abstract

A relationship between sense of humor, personality type and creativity is hypothesized. Surveys were given to engineering design students in a product development course offered at MIT. Linear correlations were found between an intuitive personality subtype and creative achievement, as well as between Gough Creativity Index and a self-defeating sense of humor style. Artificial Neural Network methods were employed to further map inputs of humor style and personality type to creativity. The thinking personality subtype was found to have greatest impact on creative achievement, though affiliative humor style also was noted as the next main contributing factor to creative achievement.

Thesis Supervisor: Maria C. Yang
Title: Associate Professor of Mechanical Engineering
and Engineering Systems

Acknowledgments

A special thanks is due to Professor Maria Yang for supervising me and allowing me to conduct this research with her.

In addition, thanks is due to Professor John Brisson for advising me and converting me to the field of Mechanical Engineering.

Another thanks to Tomonori Honda for sharing his MATLAB programming skills and lending a hand when computer problems arose.

Thank you to Justin Lai and Taylor Roan for lending their support.

I would also like to acknowledge my friends and family for their love and support, and dedicate this thesis to the MIT Latter-day Saint Student Association for they are friends as well as family.

Contents

1 Introduction **11**

1.1 Motivation 11

1.2 Hypothesis 12

1.3 Goals 13

2 Background **15**

2.1 Personality and Creativity 15

2.2 Sense of Humor and Creativity 16

3 Methods **19**

3.1 Design of Study 19

3.1.1 Personality 19

3.1.2 Sense of Humor 21

3.1.3 Creativity 22

3.2 Procedure 24

4 Results and Analysis **25**

4.1 About Neural Networks 27

4.2 Design of Artificial Neural Network 31

4.3 Artificial Neural Network Fitting Program 32

4.4 Results and Analysis of Artificial Neural Network Program 33

4.4.1 A Neural Network Using Two Outputs 36

5 Discussion **39**

6 Conclusion **41**

6.1 Future Work 42

List of Figures

4-1 Plot of Creative Achievement vs. Intuitive Subtype 26

4-2 Plot of Gough Creativity Index vs. Self-Defeating Humor 28

4-3 A pyramidal cell, a common type of neuron 29

4-4 Single Layer Processing 30

4-5 Three Layer Network Model 32

4-6 Average error vs. number of iterations (epochs) 33

4-7 Fit of data to neural network 34

4-8 Histogram of error relating to fit of the neural network 35

4-9 Average error vs. number of iterations (epochs) 36

4-10 Fit of data to neural network 37

4-11 Histogram of error relating to fit of the neural network 38

THIS PAGE INTENTIONALLY LEFT BLANK

List of Tables

3.1 Dimensions Measured by Myers-Briggs Type Indicator (Filbeck, et al, 2005). 20

4.1 The percentage of the class that falls into each MBTI personality type 25

4.2 Error from perturbing personality inputs for the neural network . . . 35

4.3 Error from perturbing humor style inputs for the neural network . . 35

4.4 Error from perturbing humor style inputs for the neural network with two outputs 37

THIS PAGE INTENTIONALLY LEFT BLANK

Chapter 1

Introduction

1.1 Motivation

Creativity should be studied for our survival; Csikszentmihalyi (1996) elaborates with survival no longer depends on biological equipment alone but on the social and cultural tools we choose to use. The inventions of the great civilizationthe arts, religions, political systems, sciences and technologiessignal the main stages along the path of cultural evolution. To be human means to be creative (P. 318).

Creative thinking is a very relevant skill to engineering, especially in the design process. New technologies are developed through creative thinking and understanding of the laws of physics. While engineering education is especially efficient at teaching the natural and mathematical sciences it has been criticized for not valuing or fostering creativity (Kazerounian & Foley, 2007). Essentially, through engineering education the left hemisphere, the analytical half, of the brain becomes highly developed, while the right hemisphere, which processes information in an intuitive way and is the half where creativity occurs, is not exercised as much.

While creativity is often thought of as an intrinsic ability, it has been related to a persons environment (Wilde, 1993). This study examines the environmental factor of humor. Humor is viewed as an environmental factor because it is a response to environmental stimuli, both in its development and use. Humor was chosen because it embodies many of the right hemispheres most powerful attributesthe ability to

place situations in context, to glimpse at the big picture, and to combine differing perspectives into new alignments (Pink, 2006, p. 198). Moreover, the brain region that Shammi and Stuss (1999) identified as important to humor is also important to novel problem solving, as such they postulate that a major theory of humor, the incongruity-resolution model, considers humor appreciation as a problem-solving task in which the punch-line, which is incongruous with the body of the text, must be detected and then reconciled with the lead (p. 663).

Amabile (1996) suggests that there is a relationship between humor and creativity, however empirical research on the relationship between creativity and humor is rare (p. 223). Koestler (1964) writes about humor from the humorists perspective and identifies the creativity involved in the process stating: the creative act of the humorist consist[s] of bringing about a momentary fusion between two habitually incompatible matrices (p. 94). He continues by citing examples of scientific discovery that could be described in the same way, such as Copernicus and Galileo. In addition, previous research is outlined in the background section.

1.2 Hypothesis

It is hypothesized that there is a positive correlation between the sense of humor and creativity. It is also hypothesized that humor style and personality type can predict creativity in the form of creative achievement. This study also hopes to prove that humor is positively correlated with creative achievement and possibly identify a specific style of humor that correlates. It is also believed that humor will be positively correlated with and extroverted personality type because of the social nature of humor, as well as the perceiving type because of the perception required to fuse two seemingly unrelated concepts together that result in humor as per Koestlers (1964) view. Finally it is believed that a particular style of humor and personality type exist that strongly determine creative achievement.

1.3 Goals

The goal of this study is to elucidate the relationship of humor style and personality type to creative achievement. This research adds to our basic understanding and how it relates to the characteristics of designers. This will perhaps result in a tool hiring managers can use towards identifying prospective employees that would be a best fit for their company. In addition, through identifying particular styles of humor conducive to creativity this study may be used to improve teaching methods in design curricula.

Using populations of graduate and undergraduate students taking product design courses, surveys will be given to assess creativity and humor. Creative achievement is a self-reported measure found by survey using the Creative Achievement Questionnaire. Humor style is also a self-reported measure identified by survey using the Humor Styles Questionnaire. In addition, the Myers-Briggs Personality Inventory is used to identify personality type.

THIS PAGE INTENTIONALLY LEFT BLANK

Chapter 2

Background

The goal of this study is to look at the combination of sense of humor and personality and how it relates to creativity. Previous work has examined the relationship between personality and creativity, humor and creativity, and even personality and humor, however none have really examined the combination. In order to better design this study it is important to gain an understanding of previous work, which is detailed in the following sections.

2.1 Personality and Creativity

Torrance (1962) writes there has long been general agreement that personality factors are important in creative achievement. Even in the matter of measuring the creative thinking abilities there have been persistent and recurrent indications that personality factors are important even in test performance (p. 65). The relationship of personality to creativity has continued to be studied. Gough (1981) developed the Gough Creativity Index (GCI), which is a linear transformation of the scores generated by the Myers-Briggs Type Indicator (MBTI).

Further work has been done in the area of personality and creativity with respect to groups. Wilde (1997) sought to address whether the GCI or other slight constraints on the formation of the design team based on personality type could predict the success of a design team. Over five years he experimented with constraints on how

students choose their design teams. His results included the production of teams that performed both qualitatively and quantitatively better than those of the thirteen years previous. In 1995, the teams won all but two of the twelve Lincoln Foundation Design Competition prizes (Wilde, 1995).

In addition Shen, Prior, White and Karamanoglu (2007) examined the formation of design teams using the MBTI and the Keirsey Temperament Sorter II. They write that there is a scarcity of MBTI information on design students and mention a previous study by Stevens (1973) that identifies a strong relationship between creativity, introversion, and intuition (Shen, et al, 2007, p. 60). They further identify a relationship between intuition and creativity: engineers and designers have 40-47% and 79% levels of intuition, high when compared with the normal population (24-27%) though much lower than fine arts students at 91% (Shen, et al, 2007, p. 61).

Finally, Torrance (1962) analyzed a number of studies identifying differentiating personality attributes between highly and less creative persons. Among these attributes is listed sense of humor (Torrance, 1962, p. 67). In children, three personality characteristics stand out as differentiating attributes, these are (1) having wild or silly ideas, (2) having work characterized by the production of ideas off the beaten track, outside the mold, and (3) having work characterized by humor, playfulness, relative lack of rigidity, and relaxation (Torrance, 1962, p 78). Positive personality characteristics and sense of humor have also been examined by Kuiper and Martin (1998) who found that although there is some overlapthere is also a considerable degree of divergence (p 176).

2.2 Sense of Humor and Creativity

This study is not the first to try and identify a relationship between sense of humor and creativity. The following are brief summaries of previous studies and their findings.

Smith and White (1964) conducted a study on the relation of wit to creativity. In their study they divided 156 Air Force personnel into groups of six, where every one knew each other, and were given the Maier Horse Trading Problem to solve.

Data measures included sociometrics, e.g. number of witty remarks made by subject S, Getzels and Jacksons Word Association Test for Creativity, self-reported humor analysis, and surveys on group satisfaction and defensiveness. They found wit and creativity to be positively correlated, defensiveness and creativity to be negatively correlated, and that wits are not necessarily effective leaders.

Treadwell (1970) examined creativity and the ability to create humor. This study examined 83 subjects who were junior and senior-level undergraduates in science and engineering. The study measured humor according to a self-report of Humor Use and Appreciation and a Cartoons Test, where subjects can write humorous and appropriate captions for the cartoons. Creativity was measured through Mednicks Remote Associates Test and the Gestalt Transformations Test. Treadwell (1970) identified intercorrelations between humor and creativity test scores and concluded the study of humor appears likely to be a useful approach in the further study of creativity (p. 57).

Hauck and Thomas (1972) examined the relationship of humor to intelligence, creativity and intentional and incidental learning in eighty students attending the fourth, fifth, and sixth grades. Using the Torrance Tests of creativity along with an association test for humor, Hauck and Thomas identified a correlation of .89 (p¡.005) between humor and creativity.

Ziv (1976) investigated the impact of listening to humor on creativity tests for 282 tenth grade students. This study divided the students into two groups, one control and one experimental whereby each group was given a pretest and three weeks later another test where the experimental group first listened to a recording of a well known comedian. Laughter is presented as a physiological response to humor and the record was chosen based on high laughter response (amplitude and duration). Ziv (1976) found that laughter response to humorous stimuli increases creative thinking in adolescents, creative thinking being defined operationally as scores on a creativity test (p. 320).

More recently, Humke and Schaefer (1996) examined the relationship of humor and creativity in 86 adults; they were mental health professionals. They used the

Multidimensional Sense of Humor Scale and the Franck Drawing Completion Test. They calculated a Pearson correlation coefficient of 0.77 ($p = .01$) between the humor and creativity scores (p. 545).

Chapter 3

Methods

3.1 Design of Study

The following sections offer definitions and further clarification of concepts examined in this study.

3.1.1 Personality

Personality, as defined by renowned psychologist Hans Eysenck (1998), is the sum-total of the actual or potential behavior-patterns of the organism, as determined by heredity and environment (p. 25). Personality is usually studied in terms of either types or traits, where types are classifications of traits, usually into sharply defined groups, and traits relate to individual action-tendencies. Carl Jung at the turn of the 20th century pioneered the concept of personality types. He identified eight personality types that were extended by Briggs and Myers through the addition of a Judging (J) and Perceiving (P) preference. They developed the Myers-Briggs Type Indicatory (MBTI) to identify personality type.

The MBTI is a widely accepted tool developed for the non-psychiatric population, and therefore benign. In the MBTI subjects self-report there behavior and preferences and receive scores with respect to four dimensions of personality divided into preferences for focusing attention, acquiring information, making deci-

Preferences for focusing attention	**Extroversion (E)** – Individuals focus attention on the outer world of people and things. They draw energy from interacting and being engaged,and so learn most effectively when they are engaged in activity.	**Introversion (I)** – Individuals focus attention on their inner world. They draw energy from internal reflection, and so learn best through reflecting and understanding the context of a problem before being engaged.
Preferences for acquiring information	**Sensing (S)** – Individuals focus on the concrete aspects of a situation and value what can be seen, touched, felt,smelled, or heard. They tend to be practical minded, concerned with details and facts, and have greater acceptance of what is given.	**Intuition (N)** – Individuals focus on the abstract, and value relationships not immediately recognizable to the physical senses. They strive to understand the "big picture" and are interested in change and future possibilities.
Preferences for making decisions	**Thinking (T)** – Individuals focus on objective decision-making based on a desire for fairness. They seek logic in their analysis of situations, desire to achieve objectivity, and prefer to work to discover what may be wrong in situations that arise.	**Feeling (F)** – Individuals focus on subjective decision-making based on a desire for harmony. They consider impacts on people in their analysis of a situation, prefer to affirm what is right with situations, and are more likely to offer appreciation and sympathy.
Preferences for orientation to the outer world	**Judging (J)** – Individuals focus on leading a life that is organized and orderly, seek closure, prefer control over their lives, and plan accordingly.	**Perceiving (P)** – Individuals focus on leading a life that is flexible and spontaneous, seek to keep decisions open, and prefer to adapt to situations rather than control them.

Note: Source: Filbeck and Smith [1996].

Table 3.1: Dimensions Measured by Myers-Briggs Type Indicator (Filbeck, et al, 2005).

sions, and orientation to the outer world corresponding to introversion-extroversion (I- E), sensing-intuitive (S-N), thinking-feeling (T-F), and judging-perceiving (J-P) respectively (Flibeck, Hatfield & Horvath, 2005). Introversion-Extroversion relates to whether people prefer to focus on the inner world of reflection and ideas or the outer world of people and things. Sensing-Intuition categorizes people into preference for deriving information through the senses and concrete aspects as opposed to abstract and big-picture thinking. The Thinking-Feeling dimension divides people based on their preference for objective or subjective decision-making. Finally, the dimension of Judging-Perceiving refers to peoples desire for closure, certainty and control over their lives as opposed to open-endedness, uncertainty, flexibility and preference for adapting to situations. See Table 3.1 below describes the personality dimensions more in depth.

3.1.2 Sense of Humor

The term sense of humor has had varied definitions and meanings over time. Sense of humor is a personality trait or individual difference variable (Ruch, 1998; Eysenck 1998). It has been studied in the contexts of appreciation, use, and production, with most studies before the 1970s focusing on appreciation. Individual variation in sense of humor may relate to differences in comprehension, expression, the ability to produce humor, appreciation, affinity and desire for laughter, memory, and use as a coping mechanism.

One of the problems cited with measures of humor is that they focus too narrowly on separate aspects of the humor construct. Humor scales which tap such limited domains as perceived humor or likelihood of laughter are too circumspect to be of general use. This lack of adequate measures led Thorson and Powell to develop a comprehensive measure of humor, i.e. the Multidimensional Sense of Humor Scale, which taps recognition of humor, appreciation of humor, playfulness, and use of humor as an adaptive coping mechanism (Humke and Schaefer 1996).

Sense of humor is has been measured in terms of affinity toward a particular type of humor, laughter response, appreciation of humor and production of humor as previously discussed. Martin, et al (2002) identified that scales such as the SHRQ [Situational Humor Response Questionnaire], SHQ [Sense of Humor Questionnaire], and MSHS [Multidimensional Sense of Humor Scale] assess the degree to which people engage in smiling and laughter, notice, enjoy, create, and express humor, and so on, but they typically do not assess the specific ways in which people use humor in their lives (p. 50). In addition, Humke and Schaefer (1996) write one of the problems cited with measures of humor is that they focus too narrowly on separate aspects of the humor construct. Humor scales which tap such limited domains as perceived humor or likelihood of laughter are too circumspect to be of general use (p. 544). As a response, he and his colleagues developed the Humor Styles Questionnaire (HSQ) which focuses on the interpersonal and intrapsychic functions that humor is made to serve by individuals in their everyday lives (Martin, et al, 2003, p. 51).

The HSQ was chosen because it is a self-reported survey relating to everyday use of humor and because its assessment is not subject to the evaluator. The HSQ divides humor use into four dimensions. They are affiliative humor, humor used to amuse others and build relationships; self-enhancing humor, humor for coping with stress, generally involving a humorous outlook on life; aggressive humor, humor that includes sarcasm and ridicule, expressing a disregard for potential impact on others; and self-defeating humor, use of humor to amuse others at ones own expense (Martin, et al. 2003).

3.1.3 Creativity

Creativity is an elusive descriptor of a person, process, or product. It is a widely used term and often used synonymously with talent and genius. However, Csikszentmihalyi (1996) distinguishes the terms from one another stating talent differs from creativity in that it focuses on innate ability to do something well and for genius he accepts that it may refer to intelligence and creativity, though a majority of creative individuals [he] interviewed reject this designation (p. 27). Amabile (1996) provides a consensual definition of creativity:

> A product or response is creative to the extent that appropriate observers independently agree it is creative. Appropriate observers are those familiar with the domain in which the product was created or the response articulated. Thus, creativity can be regarded as the quality of products or responses judged to be creative by appropriate observers, and it can be regarded as the process by which something so judged is produced (p. 33).

Essentially, a product is creative if it is both novel and useful, something that is merely novel can be considered original but not creative. Csikszentmihalyi (1996) discusses the question of where creativity is and divides it into three areas of (1) domain, or subject, (2) field, meaning the gatekeepers of the domain, e.g. curators of museums, art teachers, etc, and (3) the individual. A product is also considered

creative when it is accepted as such by the gatekeepers of the domain, or rather the field.

In examining the area of the individual, a person is designated as creative if they produce creative projects. Runco (2004) explores personal creativity, suggesting that it is manifested in the intentions and motivation to transform the objective world into original interpretations, coupled with the ability to decide when this is useful and when it is not which also supports the previous definition given with respect to a product (p. 22).

Creativity is hard to measure. Humke and Schaefer (1996) recognized that there are as many as 60 different indices of creativity (p. 544). In addition, Torrance (1962) discusses a battery of creativity tests that had been developed over the years and that the criteria and validity of these tests are not developed adequately. The 1959 Committee report on Criteria of Creativity at the Utah Conference recommended that studies examine the products of creative behavior, whereby when such products are judged to be creative, the behavior which produced them can be called creative as well a the individuals that produced them (Torrance, 1962, p. 41). Some standard indicators for measuring creativity in people are fluency, flexibility, elaboration or originality. More specifically, fluency is the ability to generate ideas, flexibility refers to the range and variety of ideas, elaboration relates to the development and ability to think through ideas, and originality refers to those ideas that are not obvious and are statistically infrequent. Creativity has been measured in the past through a variety of tests including inventories, behavioral tests, divergent thinking tests, word-building tests, interpretation of inkblots, drawing, etc.

Two major criticisms of these tests are given by Carson, et al (2005) as motivation for developing a new indicator, they write that (1) many techniques apply only to deceased or socially eminent creators and as such access is limited to them since they are few and (2) many measures of creativity rely on the subjective ratings from either expert or nonexpert judges [with] generally more than one skilled rater required to establish validity and as such is more costly in time and money (p. 39). As such they have addressed these problems through looking at the indicator of creative

achievement.

Carson, et al (2005) defines creative achievement as the sum of creative products generated by an individual in the course of his or her lifetime. A creative product, according to Barrons (1955) criteria, must be both original and functional or adapted in some pragmatic way to reality (p. 37). They developed the Creative Achievement Questionnaire (CAQ), which is used in this study. The CAQ is a self-report of creative achievement across ten domains of creativity along with a write-in section. These domains are visual arts, music, dance, architectural design creative writing, humor, inventions, scientific discovery, theater and film, and culinary arts. Within each domain there are weighted sublevels of achievement whereby higher levels of achievement are given more weight. The creative achievement score is given by the sum of achievements across the domains.

3.2 Procedure

This study was conducted with sixty students in a graduate level product design course at MIT. Electronic surveys were taken to provide personality type, sense of humor, and creativity data. These surveys included a modified version of the MBTI, the HSQ, and the CAQ.

Chapter 4

Results and Analysis

The following Table 4.1 shows the personality data of the class.

All correlations reported in the body of this report are Pearson correlations. Statistically significant correlations, termed ρ values, were found between affiliative humor style and extroverted (E) personality type ($\rho = 0.25$, $p < 0.05$, where p is the confidence level) as well as between affiliative humor and perceiving personality type (P) with a correlation $\rho = 0.35$ ($p< 0.01$). A self-defeating humor style correlated with an extroverted personality type ($\rho = 0.35$, $p < 0.01$), perceiving personality type ($\rho = 0.30$, $p < 0.05$), and feeling (F) personality type ($\rho = 0.30$, $p < 0.05$).

Most correlations between personality type and creative achievement proved weak with the exception of the intuitive (N) personality type which had a $\rho = 0.29$ ($p < 0.05$). This is seen in Figure 4-1 below.

There were no statistically significant correlations between sense of humor style

Table 4.1: The percentage of the class that falls into each MBTI personality type

ISTJ	*ISFJ*	*INFJ*	*INTJ*
23%	2%	4%	18%
ISFP	*ISFP*	*INFP*	*INTP*
0%	0%	0%	6%
ESTP	*ESFP*	*ENFP*	*ENTP*
1%	1%	7%	4%
ESTJ	*ESFJ*	*ENFJ*	*ENTJ*
14%	2%	5%	9%

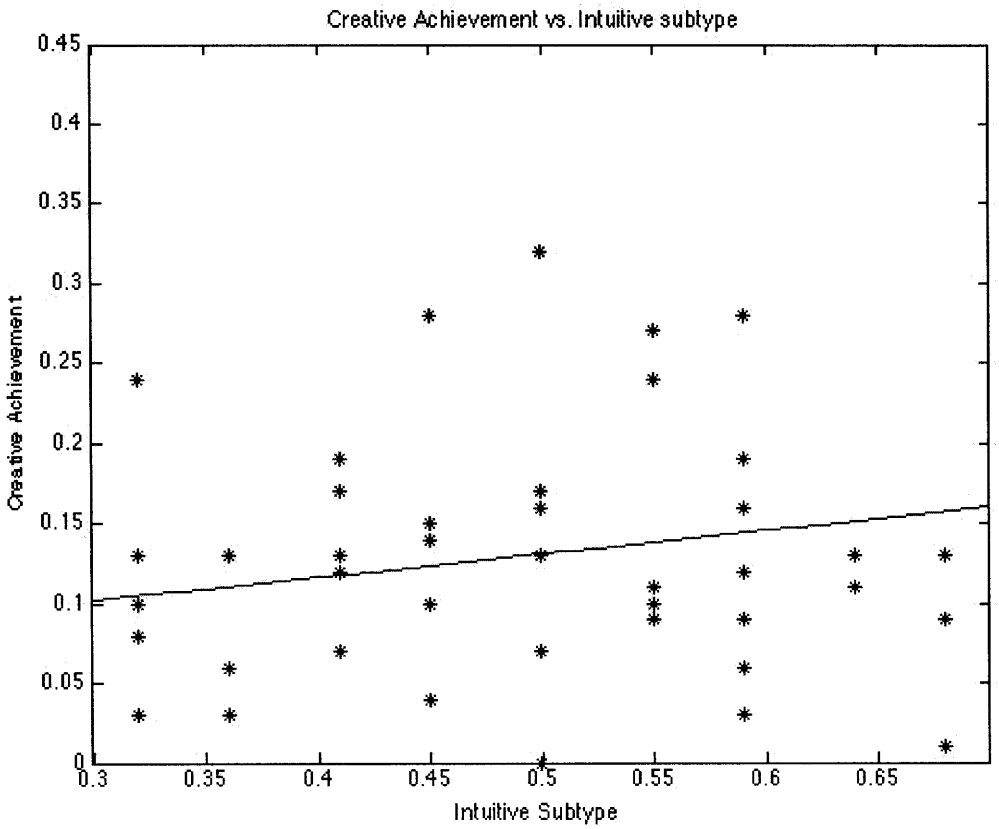

Figure 4-1: Plot of Creative Achievement vs. Intuitive Subtype

and creative achievement.

The Gough Creativity Index is a measure of creativity devised by Harold Gough (1981), which is a linear transform of the scores generated by the MBTI. It is computed as follows:

$$GCI = 250 + (-13 - 0.51) \cdot v \tag{4.1}$$

where **v** is the score vector where 50 is subtracted from the percentage of the dominant type and types INFP are assigned positive values and ESTJ are assigned negative values to center around zero. In addition vector **v** is reported in the same order as the previously mentioned types. The GCI scores were computed for each person and were normalized since the maximum GCI value of 525. A correlation $\rho = 0.35$ ($p < 0.01$) was found between GCI and a self-defeating humor style as can be seen in Figure 4-2 below.

Further analysis of results was conducted using artificial neural networks in an effort to identify patterns between personality type, sense of humor and creative achievement. The following section provides information about artificial neural networks.

4.1 About Neural Networks

A neural network is made up of neurons that are interconnected through synapses.

In the above Figure 4-3 the dendritic spines are where most of the inputs are received. The neuron processes these inputs and propagates a signal, in the form of a voltage pulse or action potential, across the axon to the synaptic terminals. At the synaptic terminals the electrical signal is transformed to a chemical signal for further transmission to other neurons. Haykin (1999) describes synapses as the elementary structural and functional units that mediate the interactions between neurons, this is where the interconnection between neurons occurs (p. 6). It should be noted that not all interconnections between neurons are equal.

An artificial neural network (ANN) is a tool used in information processing (Haykin,

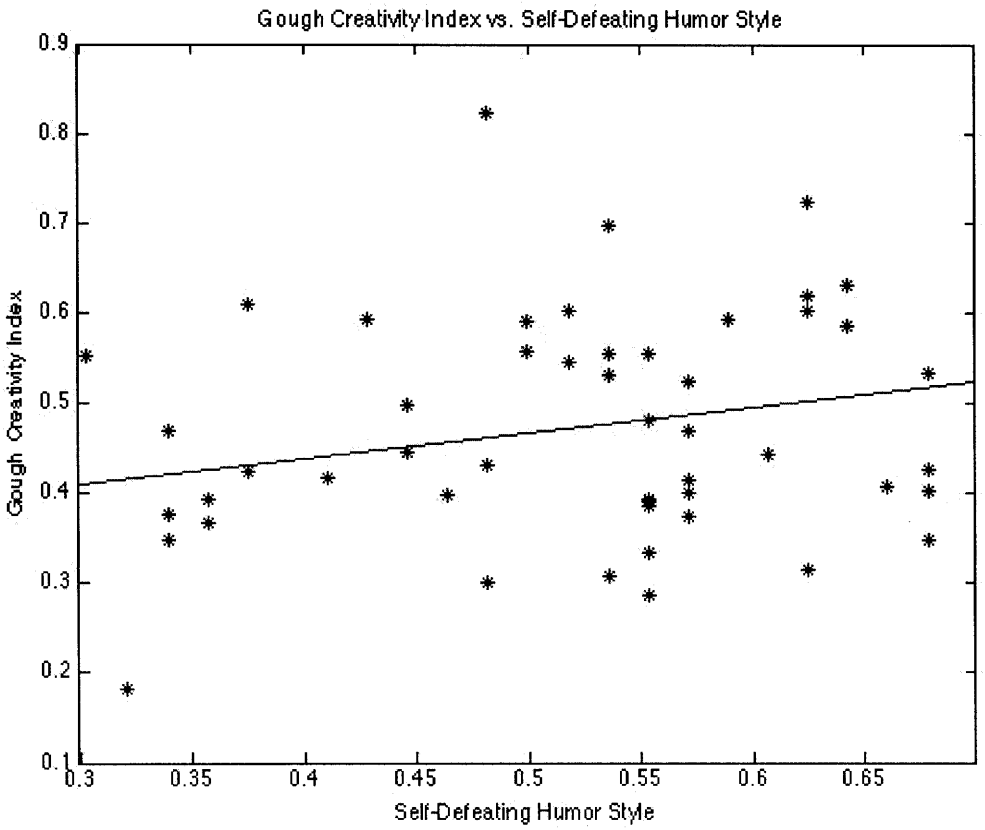

Figure 4-2: Plot of Gough Creativity Index vs. Self-Defeating Humor

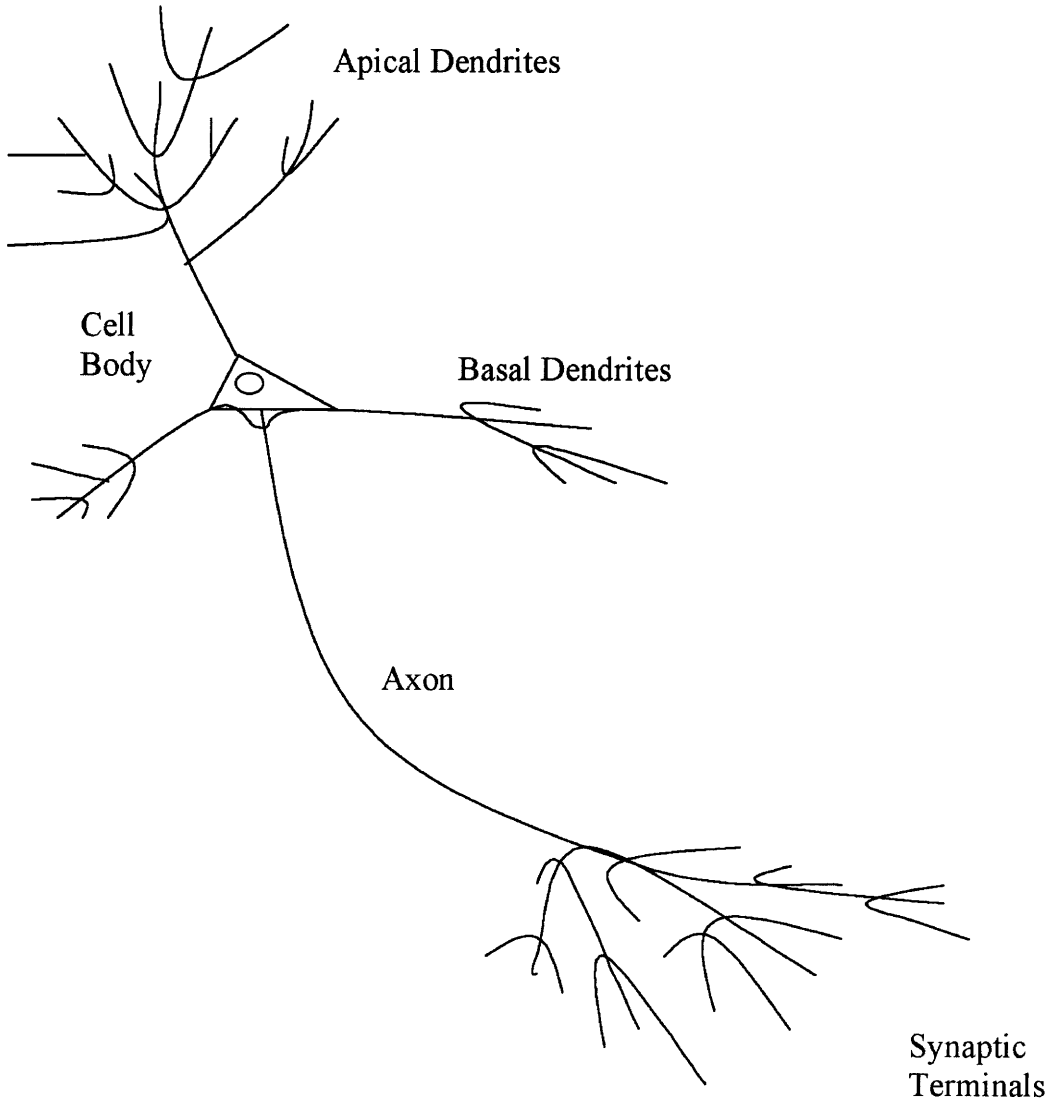

Figure 4-3: A pyramidal cell, a common type of neuron

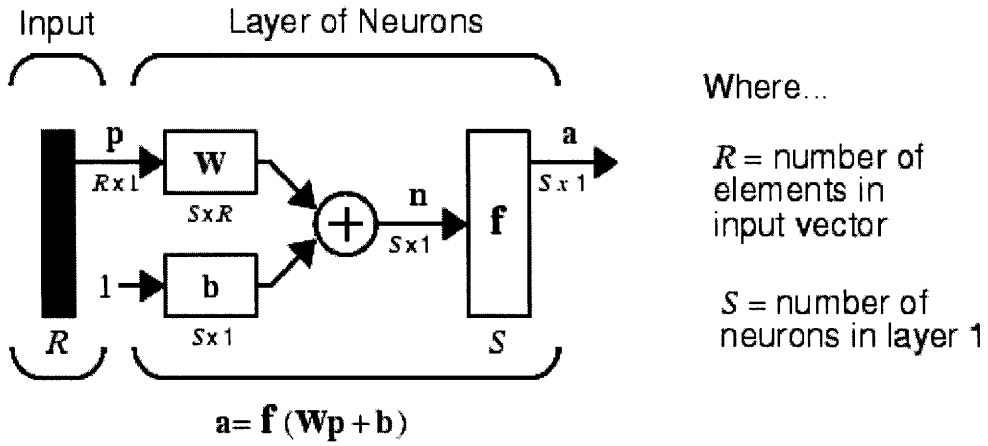

Figure 4-4: Model of process in a layer of **S** neurons. An input vector **p** is multiplied by weight matrix **W** and summed with bias **b** and then is inputted into transfer function **f** to yield neurons output **a** (Mathworks Incorporated, r2008a).

1999). The name comes from the concept of simulating the brain in its complex, non-linear processing of data. When the brain develops it creates an hard-wiring for itself; basically it learns from experience. Similarly, an ANN undergoes learning, defined by Haykin (1999) as a process by which the free parameters of a neural network are adapted through a process of stimulation by the environment in which the network is embedded (p. 50). There are many types of learning models; in this study supervised learning is used, whereby a portion of the data, inputs and outputs, is given to the network to train it to fit the data. The free parameters of the system in this case are the synaptic weights, they determine the strength of interconnection between neurons that are assigned and adapted to better map inputs to outputs. Thus, an ANN is a powerful tool for pattern recognition. The following Figure 4-4 models the basic concept of an ANN:

The process of input-output mapping is repeated for multiple samples where weight matrix **W** is initialized as a guess and adjusts itself through iterations, or epochs, as it tries to minimize error between its calculated output a and the given output. More specifically, an epoch is one pass through the training samples.

4.2 Design of Artificial Neural Network

An artificial neural network was created to identify whether there were non-linear relationships present between creative achievement and personality or humor style. Personality type and humor style data were regarded as inputs and creative achievement was the output. The artificial neural network in this study was designed with eight inputs, four were the MBTI scores and four were the humor scores for each style of humor (affiliative, self-enhancing, aggressive, and self-defeating). For analysis purposes MBTI and HSQ data were normalized. The data from the CAQ were assigned values from 0 to 1 based on the following transformation:

$$X = 1 - e^{-CAQ/25} \tag{4.2}$$

where X is the transformed data and CAQ is the score from the questionnaire. The division of the CAQ score by 25 was chosen to give X a range from 0 to 0.85 for the data collected. This range provided for the development of a more robust neural network.

Other design decisions made were with respect to the network architecture, which is the number of hidden neurons, neurons not in the input or output layers, and the number of hidden layers. While one layer of neurons was shown in previous Figure 4-4, the output a may continue on to further hidden layers of neurons before reaching the final output. Multiple layers in supervised learning problems can be used with the error back-propagation algorithm, which will be discussed later. Some rules of thumb were considered for identifying a starting architecture and the architecture was adjusted through trial-and-error through forward and backward selection methods. It is aimed to minimize the number of hidden neurons to reduce over-fitting. The final architecture used contains three hidden layers as modeled in Figure 4-5 below:

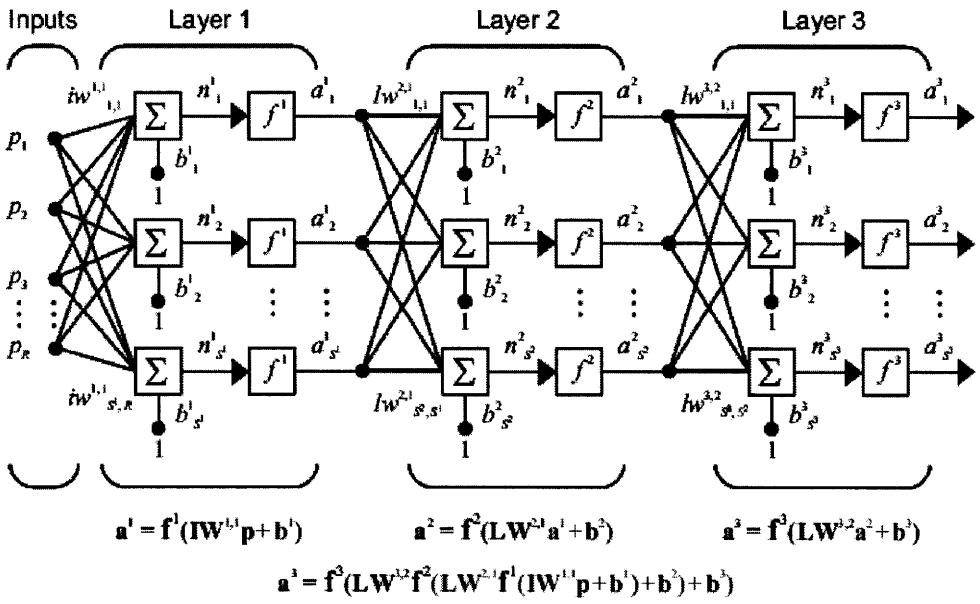

Figure 4-5: A neural network architecture with three hidden layers. Outputs of Layer 3 proceed to the output layer, which is characterized by only one output neuron (not pictured). The terms*iw*and *lw* refer to initialized and adjustable layer weights, respectively (Mathworks Incorporated, r2008a). (Mathworks Incorporated, r2008a).

4.3 Artificial Neural Network Fitting Program

The transfer function chosen was the log-sigmoid transfer function, often shortened to *logsig*. The log-sigmoid function is differentiable and as such is commonly used in back-propagation networks. Its function is given by:

$$logsig(n) = \frac{1}{1+e^{-n}} \tag{4.3}$$

The program used error back-propagation technique that consists of two passes, one forward and one backward. In the forward pass input is mapped to output. The backward pass determines the derivatives for optimization, which will be used to calculate the gradient used for optimization in the conjugate-gradient method. The conjugate gradient method is used because gradient is easily calculated and it does not require that the Hessian be calculated. For quadratic functions, the conjugate gradient finds optimum value in N iterations for an N-dimensional problem.

The training that the neural network undergoes involved randomized sampling of

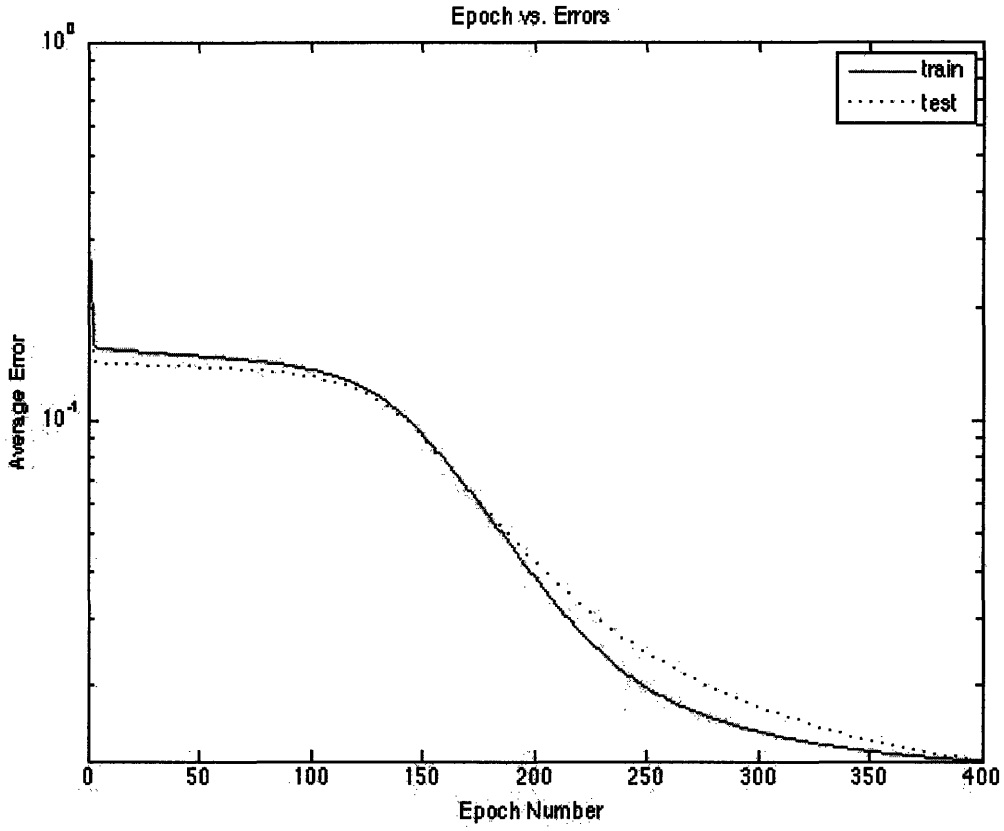

Figure 4-6: Average error vs. number of iterations (epochs)

50 of the 60 data sets. In the training the neural network tries to minimize the error. Once a network has been trained the remaining 10 data sets are used to test and validate the neural network. The program is run over 400 hundred epochs.

4.4 Results and Analysis of Artificial Neural Network Program

Since the sampling data is divided randomly into training and testing portions and there are many combinations for this sampling only a few graphs of fit will be displayed here. Multiple runs of the ANN program were conducted to ensure reasonable consistency in the network produced. Figure 4-6 below shows how well the trained network fits the test data.

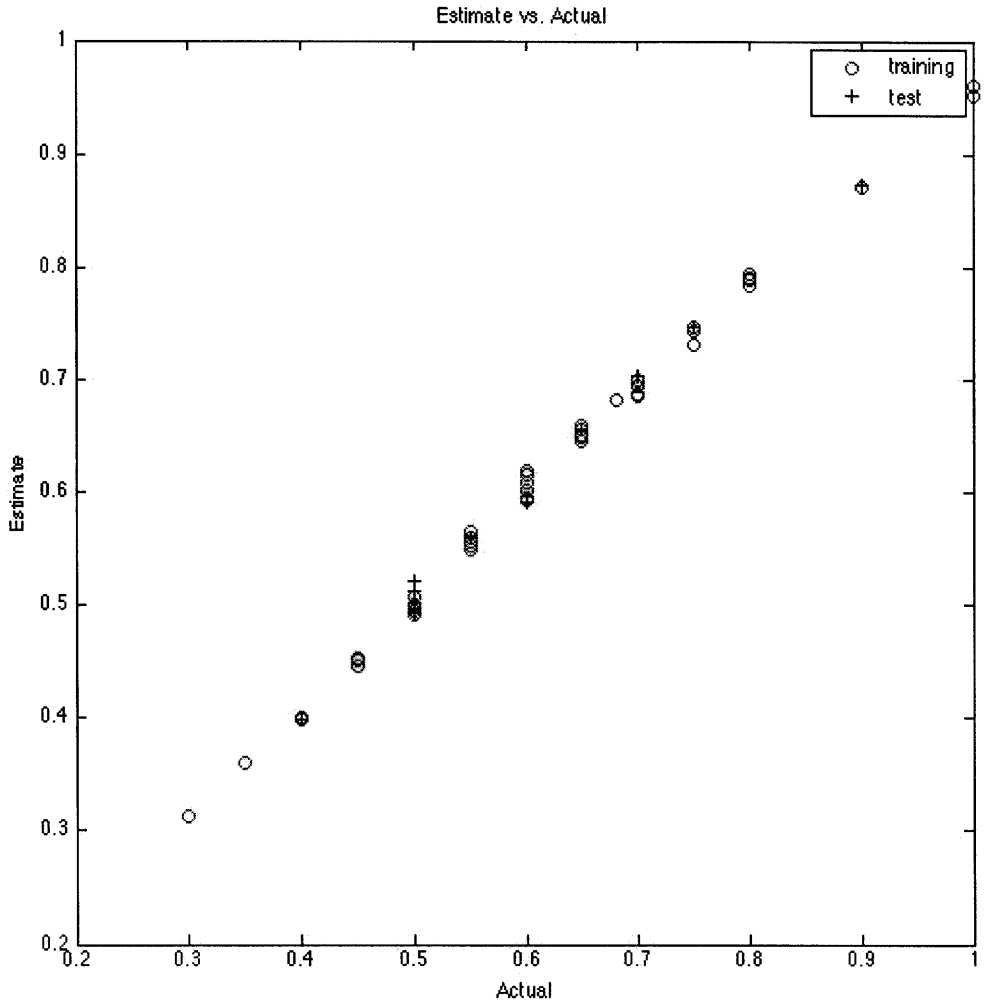

Figure 4-7: Fit of data to neural network

Next, Figure 4-7 shows the plotting of the testing data versus the training data.

Finally, Figure 4-8 below shows a histogram of the error relating to the fit of the neural network to the data.

Since the neural network is essentially a black box of functions it is easiest to identify which input values matter most by perturbing them one at a time. The following Table 4.2 and Table 4.3 show the errors for the network when each category of personality type or humor type is initialized to be a certain value. The baseline was set as the average of each category:

From the Table 4.2 and Table 4.3 it can be seen that the Thinking trait has

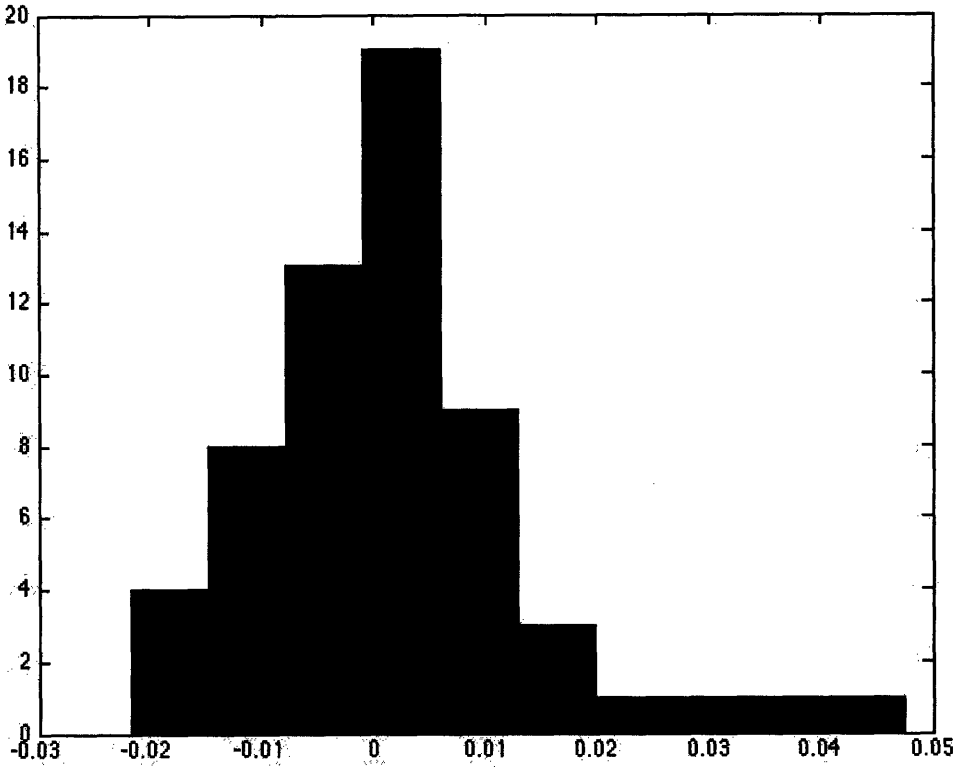

Figure 4-8: Histogram of error relating to fit of the neural network

Table 4.2: Error from perturbing personality inputs for the neural network

Initialized Value	Extroversion	Sensing	Thinking	Judging
0.00	0.002	0.007	-0.943	0.003
0.25	0.001	0.003	-0.581	0.002
0.50	0.000	0.000	-0.185	0.000
0.75	-0.001	0.004	0.200	0.000
1.00	-0.003	0.008	0.530	-0.002

Table 4.3: Error from perturbing humor style inputs for the neural network

Initialized Value	Affiliative Humor	Self-Enhancing Humor	Aggressive Humor	Self-Defeating Humor
0.00	0.046	0.018	-0.022	0.024
0.25	0.032	0.012	-0.011	0.013
0.50	0.020	0.005	0.000	0.000
0.75	0.003	-0.003	0.007	-0.012
1.00	-0.011	-0.011	0.014	-0.024

most influence in the neural network created. Thus the thinking trait is expected to correlate strongest with creative achievement. The results for humor show very little effect on the network and are thought not to be as influential on predicting creative achievement. However, the range of perturbance for affiliative humor is about five times larger than the other six inputs. On multiple runs it can be seen that an affiliative sense of humor style is the second strongest contributory variable. In addition, an aggressive humor style seems to affect creative achievement the least.

4.4.1 A Neural Network Using Two Outputs

An additional network was built using the four inputs from humor style scores and the using two outputs of Gough Creativity Index (GCI) and creative achievement. The network architecture was adjusted to consist of 2 hidden layers with [3,1] neurons each. The results that followed are seen in Figure 4-9, Figure 4-10, Figure 4-11 below:

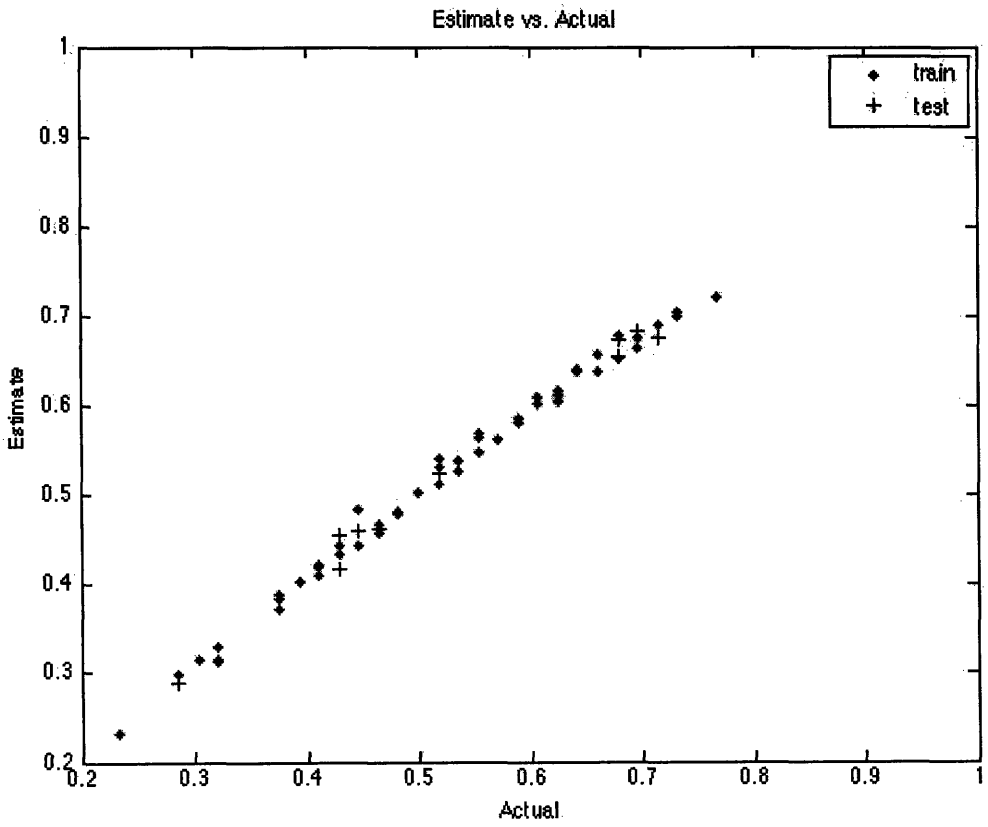

Figure 4-9: Average error vs. number of iterations (epochs)

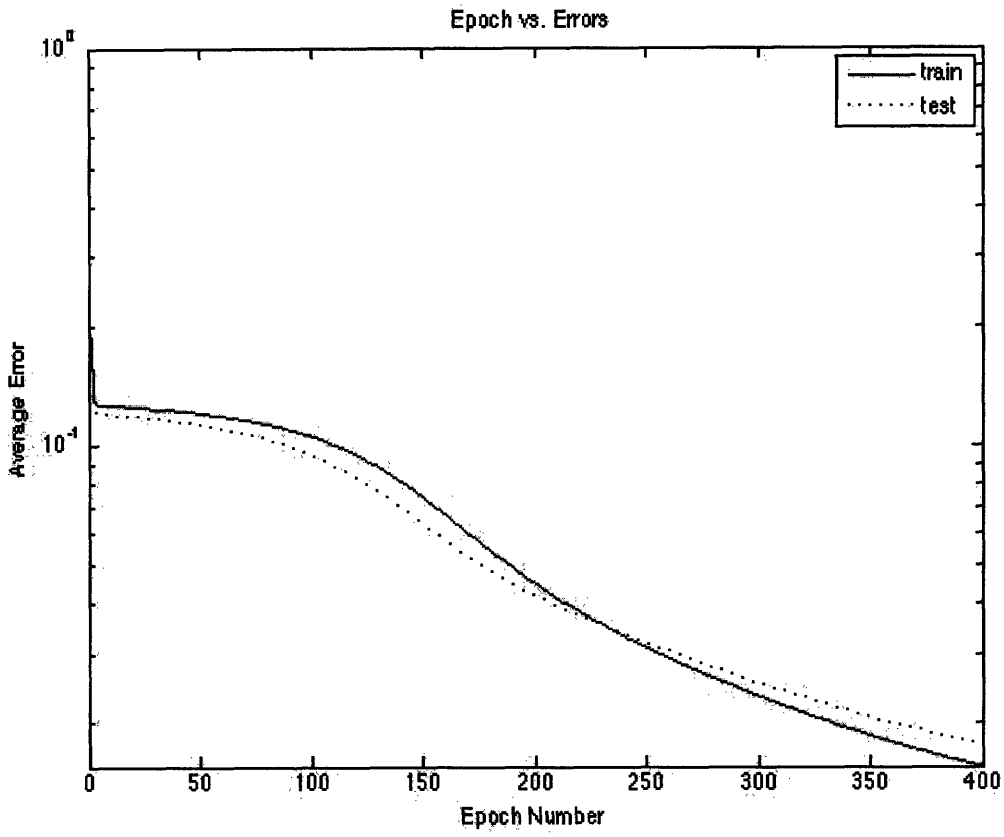

Figure 4-10: Fit of data to neural network

Table 4.4 below shows the error resulting from perturbing the humor inputs for this two output neural network.

Table 4.4: Error from perturbing humor style inputs for the neural network with two outputs

Initialized Value	Affiliative Humor	Self-Enhancing Humor	Aggressive Humor	Self-Defeating Self-Humor
0.00	0.120	0.007	-1.002	-0.027
0.25	0.084	0.004	-0.523	-0.014
0.50	0.047	0.002	-0.043	-0.001
0.75	0.009	-0.001	0.354	0.012
1.00	-0.031	-0.003	0.637	0.025

It can be seen that an aggressive style of humor has the most impact in mapping to the outputs. Second is an affiliative style of humor, and a self-enhancing humor style is least related to creativity.

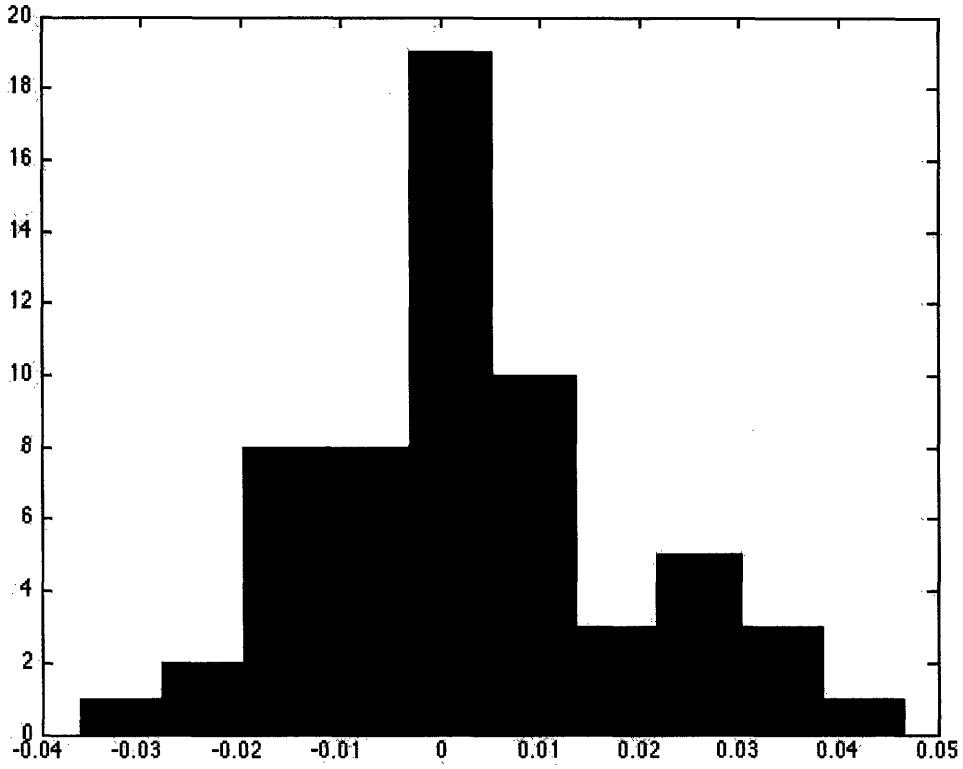

Figure 4-11: Histogram of error relating to fit of the neural network

Chapter 5

Discussion

This was the first study that tried to examine the effects of both personality and sense of humor on creative achievement. Previous studies had only compared sense of humor with creativity or personality type with creativity. One of the hopes of this study was to identify whether a particular style of humor contributed to creativity more than others in order to stimulate a more creative environment as a result through using that style more.

A weak correlation was found between creative achievement and an intuitive (N) subtype makes sense for the population since an N-type designates rationals (Shen, et al, 2007, p. 58). The N-type makes up 53% of the population so there is also a good distribution of data.

Humor style was not found to be an indicator of creative achievement. However, a weak correlation was found between the Gough Creativity Index and a self-defeating humor style.

In an effort to look for overall patterns between humor style, personality and creative achievement artificial neural networks were imposed to identify non-linearity in the relationships. The artificial neural network created identified a pattern in relating the thinking (T) personality subtype to creative achievement more than any other personality characteristic. This was largely unexpected given the previous studies as well as from looking at the Pearson correlations. However, this may be a result of the population chosen and that 79% of the population was considered to exhibit a think-

ing subtype as opposed to a feeling (F) subtype. This is biased towards engineering students as they are more thinking type than feeling type.

Furthermore, over various runs the influence of the sensing (S) subtype seemed to contribute very little to creative achievement and its impact was quite comparable to that of an aggressive humor style.

It is also interesting to note that in the computation of the GCI, intuition is much more heavily weighted than thinking, about 6 times more. In this study, intuition and thinking had no correlation with each other.

In addition, there may be some intercorrelations between the inputs that may be affecting the data. Through reducing the inputs to solely humor inputs and using the GCI and Creative Achievement scores as outputs it is highly likely that there is some intercorrelation occurring between the thinking subtype and an aggressive humor style. Perceiving and extroverted subtypes had correlations with various styles of humor. It is interesting to note that Shen, et al (2007), identified that 52.1% of their sample of 71 design students exhibited these personality subtypes, however they make up only 13% of our population of 60 students (p. 61).

Chapter 6

Conclusion

This study identified that a thinking personality subtype was a leading contributing factor for creative achievement. Affiliative humor was also noted as larger contributing factor for creative achievement though it was not nearly as influential. The bias for this study towards engineers likely constricted the data because engineering may draw a particular personality type into its field. Furthermore, having an affinity for a particular humor style may have confounding effects with personality type. As noted previously, extroverted and perceiving subtypes have some correlation with different humor styles, though there was a lack of EP types that is usually expected in an engineering population.

However this research does support some of Csikszentmihalyis contentions. In his exploration of the creative personality, Csikszentmihalyi (1996) has found a variety of types of people and personality types successful, and does not identify a particular set of traits for a person to be creative. However, Csikszentmihalyi (1996) states that creative individuals are remarkable for their ability to adapt to almost any situation and to make do with whatever is at hand to reach their goals (p. 51).

Csikszentmihalyi (1996) also states that most investigations focus on the creative person, believing that that by understanding how his or her mind works, the key to creativity will be foundFor though it is true that behind every new idea or product there is a person, it does not follow that such persons have a single characteristic responsible for the novelty (Csikszentmihalyi, 1996, p. 450). This idea is perhaps

refuted by the findings regarding the thinking subtype for personality. However, no particular personality type could be thought to contribute, as each category is not weighted equally.

So perhaps creative persons are correct in their conclusions about their success. A study conducted by Csikszentmihalyi (1996) where he asked creative persons what explains their success, one of the most frequent answers was luck (p. 46).

6.1 Future Work

Csikszentmihalyi (1996) noted creativity does not happen inside peoples heads, but in the interaction between a persons thoughts and a sociocultural phenomenon, this provides motive for a further studying the relation of group sense of humor to creative achievement (p. 23). Since humor is often a social phenomenon it is expected that group sense of humor may affect its performance. Also, previous research has identified that sense of humor facilitates social and interpersonal interactions (Ruch, 1998, P. 162). In addition, Wilde (1997) has found successful ways of organizing design teams by personality types to foster greater creative achievement. Thus there is hope that similar results might occur based on sense of humor.

References

Abuhamdeh, S., & Csikszentmihalyi, M. (2004). The artistic personality: A systems perspective. In R. J. Sternberg, E. L. Grigorenko & J. L. Singer (Eds.), *Creativity: From potential to realization* (pp. 31-42). Baltimore, Maryland: American Psychological Association.

Amabile, T. M. (1996). *Creativity in context*. Boulder, Colorado: Westview Press.

Babad, E. (1974). A multi-method approach to the assessment of humor: A critical look at humor tests. *Journal of Personality, 42*(4), 618.

Carson, S. H., Peterson, J. B., & Higgins, D. M. (2005). Reliability, validity, and factor structure of the creative achievement questionnaire. *Creativity Research Journal, 17*(1), 37-50. Retrieved from Informaworld database.

Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York: HarperCollins Publishers, Inc.

de Bono, E. (1967). *Lateral thinking*. London: Ward Lock Educational Limited.

Eysenck, H. (1998). *Dimensions of personality*. New Brunswick: Transaction Publishers.

Filbeck, G., Hatfield, P., & Horvath, P. (2005). Risk aversion and personality type. *Journal of Behavioral Finance, 6*(4), 170-180.

Hauck, W. E., & Thomas, J. W. (1972). The relationship of humor to intelligence, creativity, and intentional and incidental learning. *Journal of Experimental Education, 40*(4), 52-55.

Haykin, S. (1999). *Neural networks*. New Jersey: Prentice-Hall, Inc.

Humke, C., & Schaefer, C. (1996). Sense of humor and creativity. *Perceptual and Motor Skills, 82*, 544-546.

Jain, A. K., Mao, J., & Mohiuddin, K. M. (1996). Artificial neural networks: A tutorial.

Kazerounian, K., & Foley, S. (2007). Barriers to creativity in engineering education: A study of instructor and students perceptions. *Journal of Mechanical Design, 129*, 761-768.

Kim, Y. S., & Kang, B. G. *Personal characteristics and design-related performances in a creative engineering design course.* Unpublished manuscript.

Koestler, A. (1964). *The act of creation.* New York: The Macmillan Company.

Martin, R. A. (1998). Approaches to the sense of humor: A historical review. In W. Ruch (Ed.), *The sense of humor: Explorations of a personality characteristic* (pp. 15-60). Berlin: Mouton de Gruyter.

Martin, R. A., & Kuiper, N. A. (1998). Is sense of humor a positive personality characteristic? In W. Ruch (Ed.), *The sense of humor: Exploration of a personality characteristic* (pp. 159-178). Berlin: Mouton de Gruyter.

Martin, R. A., Puhlik-Doris, P., Larsen, G., Gray, J., & Weir, K. (2003). Individual differences in uses of humor and their relation to psychological well-being: Development of the humor styles questionnaire. *Journal of Research in Personality, 37*, 48-75.

Neuron model and network architecture. Novi, Michigan: Mathworks Incorporated.

Pink, D. H. (2006). *A whole new mind: Why right-brainers will rule the future.* New York: Riverheard Books.

Ruch, W. (1998). Sense of humor: A new look at an old concept

. In W. Ruch (Ed.), *The sense of humor: Explorations of a personality characteristic* (pp. 3-14). Berlin: Mouton de Gruyter.

Runco, M. A. (2004). Everyone has creative potential. In R. J. Sternberg, E. L. Grigorenko & J. L. Singer (Eds.), *Creativity: From potential to realization* (pp. 21-30). Baltimore, Maryland: American Psychological Association.

Shammi, P., & Stuss, D. T. (1999). Humour appreciation: A role of the right frontal lobe. *Brain, 122*, 657-666.

Shen, S., Prior, S. D., White, A. S., & Karamanoglu, M. (2007). Using personality type differences to form engineering design teams. *Engineering Education, 3*(2), 54-66.

Smith, E. E., & White, H. L. (1964). Wit, creativity, and sarcasm. *Journal of Applied Psychology, 49*(2), 131-134.

Torrance, E. P. (1964). *Guiding creative talent*. New Jersey: Prentice-Hall, Inc.

Treadwell, Y. (1970). Humor and creativity. *Psychological Reports, 26*, 55-58.

Villaverde, J. E., Godoy, D., & Amandi, A. (2006). Learning styles' recognition in e-learning environments with feed-forward neural networks. *Journal of Computer Assisted Learning, 22*, 197-206.

Wilde, D. J. (1997). Using student preferences to guide design team composition.

Ziv, A. (1976). Facilitating effects of humor on creativity.*68*(3), 318-322.