Problem Solving and Decision Making: Consideration of Individual Differences in Computer Programming Skills Using Myers Briggs Type Indicator (MBTI) and Chidamber and Kemerer Java Metrics (CKJM)

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Abstract

Purpose *- The difference in traits and behaviours of individuals affect their output when proffering solutions to problems. Since people receive, process and act upon information differently, understanding their preferences, deciding on which one to go for and communicating it in a way they understand should yield expected results.*

Design/Methodology/Approach *- The Myers-Briggs Type indicator (MBTI), a personality test which assists a person to identify some significant personal preferences was used to determine the personality traits of 30 student computer programmers of the University of Ibadan. A decision problem was given to the students, and they were expected to produce program codes which best proffered the solution to the identified problem. The quality of decisions vis-à-vis the quality of the resulting program codes was evaluated using Chidamber and Kemerer Java Metric (CKJM) tool.*

Findings *- The result of this study indicates that among the various personality traits, the Introverted Sensing Thinking Judging (ISTJ) appear to have the best programming skill followed by Introverted Intuitive Feeling Judging (INFJ) compared to other personality traits. However, in all, candidates with personality traits such as Introverted Sensing Feeling Perceiving(ISFP), Introverted Intuitive Thinking Perceiving (INTP), Extroverted Intuitive Feeling Perceiving (ENFP), Introverted Sensing Feeling Judging (ISFJ), Extroverted Intuitive Thinking Judging (ENTJ), Extroverted Sensing Feeling Judging (ESFJ), Extroverted Intuitive Feeling Judging (ENFJ), Introverted Sensing Thinking Perceiving (ISTP), and Introverted Intuitive Feeling Perceiving(INFP) are likely to be averagely good programmers while individuals with Extroverted Sensing Feeling Perceiving (ESFP) and Extroverted Sensing Thinking Perceiving (ESTP) traits are likely to make poor programmers.*

Practical Implications *- This study suggests that individual personality traits (temperamental ability) affect problem solving, decision making and programming skills of individual.*

Keywords *– Problem-solving, Personality traits, Programming skills, Myers-Briggs Type indicator, Chidamber and Kemerer metrics*

Introduction

Problem solving entails the use of specific approaches which could be generic or ad-hoc in nature. Essentially, problem solving models have been developed and used in artificial intelligence, medicine, mathematics, engineering, science, technology and management science. Decision making as mental processes results in the selection of a course of action among several alternative scenarios. Consequently, due to differences in individual preferences, they are not likely to approach problem solving and decision making in the same way and manner. For Systems Analysts, Software engineers and Programmers, problem solving and decision making skills are indispensable qualities of the profession just like all other professional disciplines (Okike, 2014b).

A person's decision making style might correlates well with how they score on the bi-polar dimensions of the Myers Briggs Type Indicator (MBTI). The Bipolar dimensions of the MBTI have been discussed in Okike (2014a). The terminal points on these dimensions are:
Extroversion (E) and Introversion (I)
Sensing (S) and Intuition (N)
Thinking (T) and Feeling (F)
Judging (J) and Perceiving (P)
Using the four personality trait pairs above, and performing all possible permutations on the traits yield the 16 different personality types namely Extraversion Sensing Thinking Judging (ESTJ),

Extraversion Sensing Thinking Perceiving (ESTP), Extraversion Sensing Feeling Judging (ESFJ), Extraversion Sensing Feeling Perceiving (ESFP), Introversion Sensing Thinking Judging (ISTJ), Introversion Sensing Thinking Perceiving (ISTP), Introversion Sensing Feeling Judging (ISFJ), Introversion Sensing Feeling Perceiving (ISFP), Extraversion Intuition Thinking Judging (ENTJ), Extraversion Intuition Thinking Perceiving (ENTP), Extraversion Intuition Feeling Judging (ENFJ), Extraversion Intuition Feeling Perceiving (ENFP), Introversion Intuition Thinking Judging (INTJ), Introversion Intuition Thinking Perceiving (INTP), Introversion Intuition Feeling Judging (INFJ), Introversion Intuition Feeling Perceiving (INFP).

Problem Statement

Problem solving entails lots of decision making. One way of assessing the quality of decision made is by looking at the quality of solutions proffered to problems. This may be tested in the field of computer programming by defining a problem and developing computer programs to solve the problem. Computer programming entails lots of decision making in order to get effective and efficient solutions to problems. In addition Computer programs also form the basis with which interfaces are designed, which is a platform on which end users make decisions. Consequently, the personality traits of computer programmers needs to be investigated in order to understand their preferences (introverts/ extraverts,Sensing/Intuition, thinking/feeling and Judging/perceiving) and thereby predict their decision making skills using the codes they develop.

Objective

The objective of this study is to explore the problem solving and decision making abilities of computer programmers with consideration of individual programmer personality traits and the quality of codes they produce

Research Questions

The following research questions are investigated in this study.

- What are the personality traits of good computer programmers?
- Which personality traits evolved quality decisions representing solutions to a programming task?

Research Hypotheses

The following hypotheses are tested in this study:

- H0: Introverts have better decision making skills than extroverts in code design

  H1: Introverts do not have better decision making skills than extroverts in code design

- H0: Sensors have better decision making skills in code design than intuitive

  H1: Sensors do not have better decision making skills than intuitive in code design

- H0: Thinkers have better decision making skills than feelers in code design

  H1: Thinkers do not have better decision making skills than feelers in code design

- H0: Judges have better decision making skills than Perceivers in code design

  H1: Judges do not have better decision making skills than perceivers in code design

- H0: There is significant correlation between personality traits and quality decision making in code design

  H1: There is no correlation between personality traits and quality of decision making in code design examinations

The rest of this paper is divided into 6 sections. Section 2 is a review of relevant literature. Section 3 explains the research methodology. Section 4 presents the result of this study with appropriate discussion. Section 5 is the conclusion while section 6 is the list of references

Literature Review

Mayer and Wittrock (2006, p. 287) explain problem solving as a cognitive process directed at achieving a goal when no solution method is

obvious to the problem solver. This definition consists of four parts namely:

- Problem solving is cognitive. Problem solving occurs within the problem solver's cognitive system and can only be inferred from the problem solver's behaviour.
- Problem solving is a process. Problem solving involves applying cognitive processes to cognitive representations in the problem solver's cognitive system.
- Problem solving is directed. Problem solving is guided by the problem solver's goals.
- Problem solving is personal. Problem solving depends on the knowledge and skill of the problem solver.

Wang and Chew (2010) emphasize that in problem solving, the brain searches for a solution for a given problem or finds a path to reach a given goal. Problem solving can also be a search process in the memory space. Furthermore, problem solving and decision makes models include four phases as identified in the works of Bransford and Stein (1984). These four phases are:

- Input phase where a problem is perceived and an attempt is made to understand the situation or problem
- Processing phase where alternatives are generated and evaluated and a solution is selected
- Output phase where planning for and implementing the solution is evolved.
- Review phase where the solution is evaluated and modifications are made.

Huitt (1992) also point out that researchers often describe the problem-solving and decision-making process as beginning with the perception of a gap and ending with the implementation and evaluation of a solution to fill that gap. Citing the works of other researchers, Huitt notes the following relations between personality types and problem solving:

- Introversion will want to take time to think and clarify their ideas before they begin talking
- Extraversion will want to talk through their ideas in order to clarify them.
- Introverts will more likely be concerned with their own understanding of important concepts and ideas
- Extroverts will continually seek feedback from the environment about the viability of their ideas.
- Sensors more likely pay attention to facts, details, and reality. They also tend to select standard solutions that have worked in the past.
- Intuitionists attend to the meaningfulness of the facts, the relationships among the facts, and the possibilities of future events that can be imagined from these facts. They exhibit a tendency to develop new, original solutions rather than use what has worked previously.
- Thinkers use logic and analysis during problem solving. They value objectivity and are impersonal in drawing conclusions as they want solutions to make sense in terms of the facts, and models
- Feelers consider values and feelings in the problem-solving process. They are subjective in their decision making and do consider how their decisions affect other people.
- Judges prefer structure and organization and want the problem-solving process to demonstrate closure.
- Perceivers prefer flexibility, adaptability and consider a variety of techniques during problem solving in order to avoid unforeseen changes.

In McCaulley (1987), the problem-solving characteristics of Introvert Sensing Thinking Judging (ISTJ) and Extrovert Intuition Feeling Perceiving (ENFP) are described as follows:

- ISTJ want a clear idea of the problem (I), attack it by looking for the facts (S) and rely on a logical, impersonal (T), step-by-step approach in reaching conclusions.
- ENFP throw out all possibilities (N), seek feedback from the environment to clarify the problem (E), brainstorm with (NP) , and emphasize the human aspects of the problem (F) over impersonal, technical issues (T).
- ISTJ may views the ENFP approach as irrational or scattered.
- ENFP may view the ISTJ approach as slow and unimaginative.

Furthermore, studies also indicate that personality can influence productivity and by implication the decision making process of individuals. Okike 2014(b) investigated the role of personality traits in students' achievements in computing science. Results from the study suggest that the strongest motivator for a choice of career in the computing sciences is the desire to become a computing professional rather a student's inherent temperamental ability (personality traits). Equally, students' achievements in the computing sciences do not depend only on personality traits, motivation for choice of course of study, and reading habits but also on the use of Internet based sources more going to the university library to use book materials available in all areas. Bentley (2005) reviewed personality traits and programmer characteristics and presented some of the traits that can be indicators of success or failure in computer programming. Weinberg (1998) explored the psychology of computer programming and noted that there could be variations in individual productivity due to personality type factor. Capretz (2003) investigated personality types of software engineers based on the combined Jung and Myers Briggs bipolars. The study suggested that they were more (Introvert Sensing Thinking Judging (ISTJ) software engineers than other types in his data. Chung (1986) studied the cognitive abilities in computer programming using 523 form four secondary school students in Hong Kong. Test administered to the students included mathematics, space, symbols, hidden figures and programming ability. Results of this study suggested that performance in mathematics and spatial tests were significant predictors in programming ability. Similarly, Bishop-Clark and Wheeler (1994) investigated the Myers-Briggs personality type and its relationship to computer programming. Using 114 students, the study sought to know if college students with certain personality types performed better than others in an introductory programming course. In this study, results suggested that sensing students performed significantly better than intuition students in programming assignments while judging students performed better than perception students on computer programs although the results were not significant statistically.

Research Methodology

The Myers-Briggs Type Indicator (MBTI) and Chidamber and Kemerer's Lack of Cohesion in Methods (LCOM) metric were used in the study of 30 selected undergraduate student programmers at the University of Ibadan, Nigeria. A decision problem representing a programming task was given to the students. The students were expected to produce computer programs which solves the given problem. The MBTI, an automated personality traits questionnaire based tool was administered on the students. The responses from students were automatically analysed in order identify the personality traits of each student. The program code or codes written by each students was also analyzed using a Chidamber & Kemerer Java Metric (CKJM) tool, and the results matched with their corresponding MBTI to determine the problem solving and decision making skill of each programmer by looking at the cohesiveness of the resulting program code. A cohesive program range [0,1] is a measure of program quality (Okike 2010a, Okike 2007).

Result and Discussion

The results of this study are shown in Tables 1. 2 and 3. Table 1 presents the score of personality type of participant student programmers. The result was obtained using the Myers Briggs Type Indicator (MBTI) tool, while Table2 was obtained using a Chidamber and Kemerer Java Metric (CKJM) tool . This tool measures code quality using the Lack of Cohesion in Methods (LCOM) metric (Okike, 2010a, 2010b, 2007). Also figure 1 below shows the graph of participants with particular MBTI.

Table 1: Distribution of Personality Types

Personality Type	Participants
ESTJ	4
ESTP	1
ESFJ	1
ESFP	1
ENTJ	3
ENTP	0
ENFJ	1
ENFP	2
ISTJ	5
ISTP	2
ISFJ	2
ISFP	1
INTJ	0
INTP	3
INFJ	2
INFP	1
Total	29

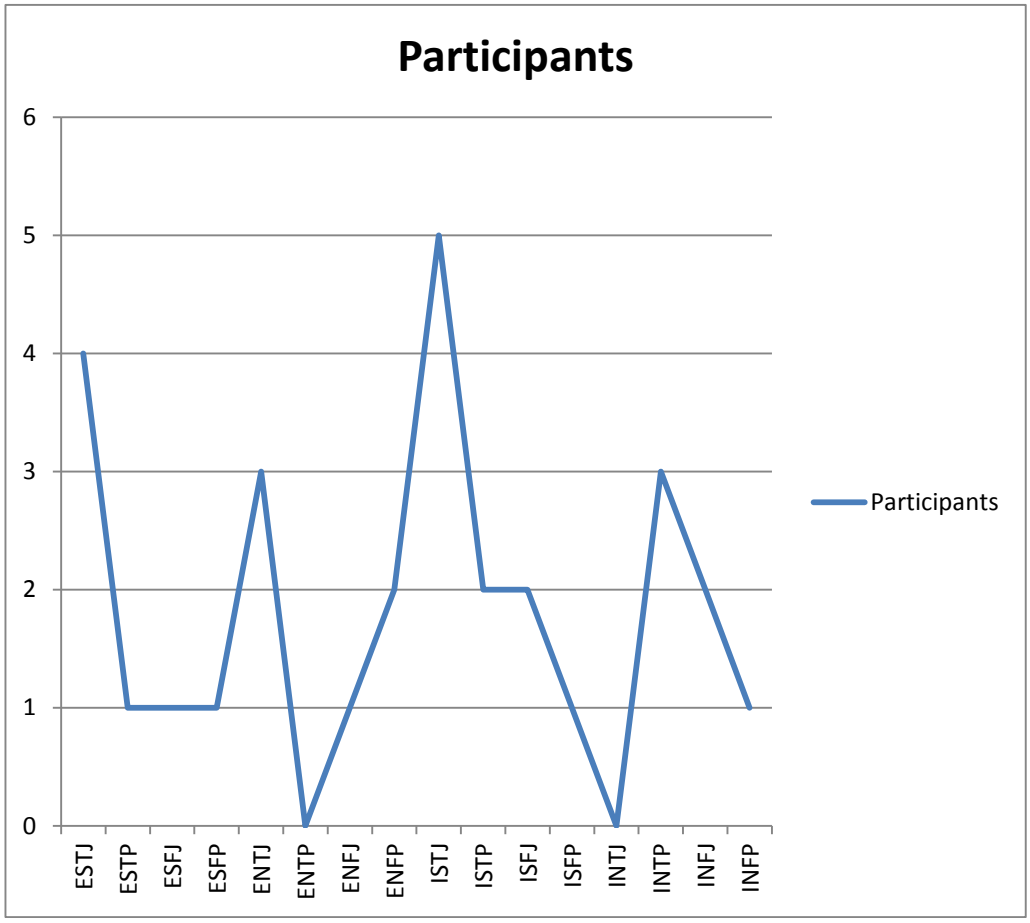

Figure 1: Graph showing participants with a particular MBTI

Table 2: Code Quality Measure Using Chidamber and Kemerer Cohesion Metric

Programmer ID	Personality Type (MBTI)	Lines of Code	Code Quality Measure LCOM [0,1]
001	INTP	24	1
002	INTP	127	142
003	ESTJ	187	115
004	ISTJ	40	1
005	ISFJ	129	21
006	INTP	111	1
007	ESTJ	121	15
008	ENFP	72	1
009	ISTP	125	34
010	ESFP	130	13
011	ENTJ	124	22
012	ENFP	70	10
013	ISTJ	63	1
014	INFJ	89	1
015	ISFJ	55	1
016	ESTJ	59	1
017	ESFJ	85	1
018	ISTJ	58	1
019	INFJ	85	1
020	ENTJ	84	1
021	ENFJ	97	1
022	ISTJ	109	0
023	ESTP	81	3
024	ISTP	57	1
025	ENTJ	139	21
026	ISFP	63	1
027	INFP	90 38	1 6
028	ISTJ	56 119 250	16 1 6
029	ESTJ	122 34	97 1

Table 1 above presents the personality distribution of student programmers using the Myers Briggs Type Indicator (MBTI). The Table provides answer to research question 1 (bullet). The highest personality type among the participants is Introverted Sensing Thinking Judging (ISTJ) with a score of 5 on the MBTI scale. Other scores on the MBTI scale are Extraverted Sensing Feeling Judging (ESTJ) 4, Extroverted Intuitive Thinking Judging (ENTJ) 3. Extroverted Intuitive Feeling Perceiving (ENFP), Introverted Sensing Thinking Perceiving (ISTP), Introverted Sensing Feeling Judging (ISFJ), and Introverted Intuitive Feeling Judging (INFJ) each show a score of 2. Traits such as ESTP, ESTJ, ESFP, ENFJ, ISFP, and INFP each has 1. There are no candidates with the personality traits ENTP, and INTJ hence the score of 0. These results are also shown graphically in figure 1 above.

Table2 above shows the result of analysing the quality of codes produced by each programmer using the Chidamber and Kemerer cohesion metric tool. The table provides answer to research question 2 (bullet). The tool reveals that 34 classes were designed. Each participant using the Java language to solve the problem wrote at least 1 class, but participants no (27-29) wrote more than one class to solve the same problem. Of all 34 classes, 19 classes were cohesive (properly designed). For a good class design, Cohesion is [0, 1] (Okike, 2007, & 2010; Chidamber and Kemerer 1994). Hence candidate with serial numbers 001- 004, 006, 008, 013-022, 024, 026-029 wrote good programs (research question 2 bullet). Candidates 001 and

004 are INTP, Candidates 004, 013, 018, 022 and 028 are ISTJ, Candidate 008 is ENFP, Candidate 014 and 019 are INFJ, Candidate 015 is ISFJ, Candidates 016 and 029 are ESTJ, Candidate 017 is ESFJ, Candidate 020 is ENTJ, Candidate 021 is ENFJ, Candidate 024 is ISTP, Candidate 026 is ISFP and finally Candidate 027 is INFP.

Table 3: Personality Traits with Cohesive Program

	Introverts (I)	Extroverts (E)	Sensing (S)	Thinking (T)	Judging (J)	Intuition (N)	Perceiving (P)	Feeling (F)
No. of Quality program	6	4	5	4	6	5	4	6

Table 3 shows the personality trait with corresponding number of quality programs. Cohesive programs are well designed programs. The table provides answers to the research hypotheses. Table 3 was generated from Table 2 by isolating all the personality traits whose program codes are cohesive, LCOM range [0, 1]. Counting the individual bipolar elements among the cohesive traits would simply yield the Table.

Conclusion

Individuals with MBTI personality trait in this order of priority ISTJ, INFJ, INTP, ENFP, ISFJ, ESTJ, ESFJ, ENFJ, ISTP, and INFP are likely to be good programmers (research question bullet 2) while individuals with other traits are likely to make poor programmers. Therefore programmers showing the personality trait ISTJ (Introverted Sensing Thinking Judging) produced 4 cohesive (quality) programs, INFJ produced 2 quality programs, INTP produced 2, ENFP, ISFJ, ESTJ, ESFJ, ENFJ, ISTP and INFP produced 1 quality program each respectively. From the foregoing, answers to the research hypotheses may be deduced as shown in Table 3. From Table 3 and with regards to computer programming, Introverts are likely to have better problem solving and decision making skills than extroverts (hypothesis 1 bullet). Sensors and Intuitive could have the same problem solving and decision making skill (Hypothesis 2 bullet). Feelers may have better problem solving and decision making skill than thinkers (hypothesis 3 bullet). Judges could have better problem solving and decision making skill than perceivers. The conclusion of this study could be verified with a larger set of data.

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