Spring 2010

Towards a Theory of Understanding within Problem Situations

Jose J. Padilla
Old Dominion University

TOWARDS A THEORY OF UNDERSTANDING WITHIN PROBLEM SITUATIONS

by

Jose J. Padilla
B.S. Industrial Engineering, June 1997, Universidad Nacional de Colombia
M.B.A. International Business, May 2003, Lynn University

A Dissertation Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirement for the Degree of

DOCTOR OF PHILOSOPHY

ENGINEERING MANAGEMENT

OLD DOMINION UNIVERSITY
May 2010

Approved by:

Andres A. Sousa-Poza (Director)

Andreas Tolk (Member)

Rafael E. Landaeta (Member)

Adrian V. Gheorghe (Member)

Arturo Tejada Ruiz (Member)

ABSTRACT

TOWARDS A THEORY OF UNDERSTANDING WITHIN PROBLEM SITUATIONS

Jose J. Padilla
Old Dominion University, 2010
Director: Dr. Andres A. Sosa-Poza

The concept of understanding is ambiguously used across areas of study, such as philosophy and cognitive sciences. This ambiguity partly originates from understanding's generally accepted definition of 'grasping' of something. Further, the concept is confounded with concurrent processes such as learning and decision making. This dissertation provides a general theory of understanding (GTU) that explains the concept of understanding unambiguously and separated from concurrent processes.

The GTU distinguishes between the process of understanding and its outcomes. Understanding, defined as a process, is the matching of knowledge, worldview, and problem. The outcome of this process is the assignment of a truth value to a problem, the generation of knowledge and the generation of worldview. Both accounts say what understanding is and what it does. Additionally, a construct of understanding is proposed to provide insight into the process of understanding. The construct does not only help explain existing theories about understanding, but also adds to the body of knowledge by identifying three types of understanding. Two exist in the literature while the third type is a contribution of this dissertation. Generalizing from the data it is shown how complexity of a problem depends on the effort an individual had to understand. It emerges that effort to understand converges to seven levels.

The theory provides insights in areas of interest to Engineering Management such as complexity and complexity's dependence on the observer while differentiating understanding from concurrent processes such as learning and decision making.

To Alexandra: you are, therefore I am

ACKNOWLEDGMENTS

I once heard that raising a Ph.D. is very much like raising a child; it takes a village.

I would like to thank my advisor, Dr. Andres Avelino Sousa-Poza for sharing his ideas and vision, and making me aware of the risks and satisfactions of doing good research. I also would like to thank my committee members, for each provided a unique contribution to this work. To Dr. Andreas Tolk I am indebted for supporting the modeling and simulation effort at a point of great doubt and for encouraging me to make this work better. To Dr. Rafael Ernesto Landaeta I am indebted for providing the pragmatic worldview needed to keep ideas in perspective. To Dr. Adrian Velicu Gheorghe I am indebted for reminding me that this was a work that needed to contribute to engineering. Finally, to Dr. Arturo Tejada-Ruiz I am indebted for providing the empirical worldview that forced me to think in ways how to relate this research with the observable phenomenon.

I would like to thank the Engineering Management and Systems Engineering Department for supporting my research effort all these years. Thank you Kim Sibson and Peggy Anthony for making my life a lot less complicated when most needed. I would like to thank the good people of the International Students Services at ODU. Special thanks go to Robbin Fulmore, Sara Eser, and Emma Studer for caring and going beyond the call of duty to facilitate a task that is everything but easy. I would like to thank The National Centers for System of Systems and its team, past and present, for being my research home. Thanks Samuel F. Kovacic and David Ekker for always providing a good chat and insightful comments on the early stages of my research. Thank you Dr. Kevin McG. Adams for always providing a good laugh and moral support. Thanks to Behnido Y. Calida for being a great friend, colleague, for helping me with the document, and bearing with my daily constant annoyance; to Van E., Brewer for his great insights and ideas; and to Bradford Logan for being just Brad. Special thanks go to Dr. Charles B. Keating; thank you Chuck for your guidance and for making me participant of the efforts at the center.

I would like to extend special thanks to almost Dr. Saikou Yaya Diallo; brother, I would most definitely not have been able to take this work to the next level if it was not for your help. Kobe and Phil would be very envious of your coaching skills. To my darling Dr. Ipek Raquel-Paulina Bozkurt thanks for not only being my long-time sparring of ideas and a great colleague, but also for being a great friend and personal influence. To Mr. Locutus, thank you for being the personification of two greats: obnoxiousness and heart whose greatnesses are only comparable to one another. I thank Mrs. Locutus for taking care of you for us by being as strangely peculiar as she is. To my friend Carlos Mario Aristizabal, thanks for one day whispering courage to my ear and convincing me that coming to the United States was a good idea. Your ideas, Caliche, should come with a warning (it is a good thing that those ideas are now Ipek's problems). To my dear friend Dr. Heber Alvino Herencia-Zapana, thank you for all our great "discussions" and for making me realize that unicorns exist only metaphorically. To my good friend Elkin Rodriguez-Velasquez, thank you for not letting me pluck my hair out of my skull battling poor data handling and coding. To Dr. Andrew Collins, thank you for your feedback with the model. Your comments went very far.

I am extremely grateful to the families Bedoya-Correa, Parra-Mesa, and Garcia-Raskovic. What you have done for me and my family I will never be able to repay. Yaneth, I am thankful because of your stubbornness and constant encouragement I have a Ph.D. today; Leo, thank you for caring for me when I was ill and for providing ideas throughout my dissertation; Bladimir, Nancy, Andres, and Emily thank you for all your prayers. To my "compadre" Hector Manuel; I hope that when I grow up I could be, at the very least, as half as cool as you are. Thanks Marija for your constant support.

To all my friends, near and far, who have made my home everywhere I have gone. To Dr. Pinar Eugenia Ozdural for presenting me the hidden pleasures of cucumber soup and yogurt; to Dr. Gamze Patricia Karayaz for presenting me the quirkiness of white lion's milk, a.k.a. rakı; to Alvaro Corea for always bringing a good bottle of rum; to Dr. John William Branch for always sharing a good beer and a good discussion; to Gloria Stella Salazar for your good vibes; to Claudia Patricia Madrid for your emails of support;

to Roberto Carlos Cabrales for still being close despite the distance; to Fredy Hernan Martinez for being one of my oldest friends; to Fredy Alberto Jaramillo for your contagious sense of humor; to Darwin Botero and Fabian Edgardo Herrera for showing me around when I knew nobody; to Isik Ali Ozcer for stealing Pinar from us; to Billur Andrea Celebi for being our newest Turkish representation; to Gulnihal Bozkurt for those delicious desserts and the annual "Turkish" dinner; to Alihan Antonio, Doha Tatiana, and Onur Francisco for your moral support; to free spirited Ersin Ancel for providing an engineering-fresh-of-breath air perspective to problems; to the greatest baklava baker Berna Eren Tokgoz; to Katherine Sofia Palacio and Luis Gabriel Carvajalino for reminding of my roots and the idiosyncrasies of my land. Thank you all for making my life better and as painless as possible throughout all these years.

To my dear family back home, thank you for bearing the distance and for still being cheerful. One could never ask for better parents, Pepe and Nayade; for better siblings, Nelson Javier, Carlos Gabriel, Juan Nicolas, and Maria Esther, and for better nieces and nephews, Liliana, Angelica, John David, Gabriela, Juan Sebastian, Daniela, and Maria Jose. Thank you Maria Cristina, my dearest cousin, for always sending me pictures of the family. To the late Charro y Santoya, thank you for always believing in me and making me the most loved grandson ever. To Dolly, Rocio, Jose Leonardo, and Sebas, thank you for your love, for always keeping me in mind and for sending me goodies.

To my dogs, Wrinkles Alejandro, Luna Jose, and Red Intenso for always making me laugh, keeping me sane, and providing the little exercise I have had in these years.

To my wife Alexandra Maria, thank you for having the patience of a saint, the sweetness of ripe plantains, and a smile that makes all worries go away.

Thank you Lord because with every challenge came the strength to overcome it and caring friends and family to support me.

TABLE OF CONTENTS

Page

LIST OF TABLES

Table Page

Table Page

LIST OF FIGURES

Figure Page

Figure Page

LIST OF DEFINITIONS

1 INTRODUCTION

1.1 OVERVIEW

The concept of understanding, although widely used across domains, is described differently depending on the area of study. Further, these descriptions, in the majority of cases, are based on the informal dictionary definition of 'grasping' something. This variety of informal descriptions leads to three problems. First, descriptions do not amount to a definition of the concept. Understanding needs to be defined for what it is and not for what it does. Second, different descriptions of the term have generated ambiguity in its use. This ambiguity leads to the concept being confounded with closely related and concurrent processes such as learning and decision making. Finally, these descriptions are built under the assumption than an objectively defined and bounded problem can be formulated. This assumption breaks down when dealing with subjectively defined problems which are common in disciplines such as Engineering Management and Systems Engineering or Modeling and Simulation (M&S) .

In order to provide an unambiguous definition of the concept, a general theory of understanding (GTU), from the perspective of an individual, is provided. This theory is not only consistent with the state of the art but also differentiates understanding from learning and decision making.

Furthermore, the GTU distinguishes between the process of understanding and its outcomes. Understanding, defined as a process, is the matching of knowledge, worldview, and problem. The outcome of this process is the assignment of a truth value to a problem, the generation of knowledge and the generation of worldview.

At the core of the GTU is the Understanding Construct (UC). The UC is a conceptualization (model) formed by the triple of knowledge, worldview, and problem and their possible interactions. Through the UC, the GTU identifies three types of understanding. The first, and most common is understanding of knowledge based on the application of knowledge. The second type of understanding refers to understanding

---

This dissertation uses the APA referencing style a problem based on knowledge formulation. The third type is understanding a problem through problem formulation. The first two types of understanding are found in the literature as two schools of thought. These two schools of thought do not acknowledge the existence of one another and abide by the objectivity assumption. The third type was discovered based on the UC proposed in this research.

The UC paired with proposed definitions were used to build a simulation. Simulation is used to generate data and draw insight that contributes to the GTU. Insight shows that the mismatch of knowledge, worldview, and problem amount to the effort an individual requires to understand a problem. Further, effort to understand, from different individuals, converges to seven different levels. Given that some individuals require more effort to understand a problem, effort can be considered as a subjective measure of complexity.

1.2 RESEARCH SIGNIFICANCE

Understanding, according to Franklin (1981), is one of the few terms so widely employed that as a word, we understand it, yet it is so little examined in contemporary English-speaking philosophy. Nickerson (1985) contends that a fundamental limitation on our ability to assess understanding stems from the difficulty we encounter in trying to define the concept in a satisfactory manner. Nickerson states that until any definition is developed, researchers are going to have difficulties even establishing methodologies to determine the degree of understanding attained in a particular instance.

De Regt and Dieks (2005) state that if the epistemic aim of science is to generate factual knowledge of natural phenomena; the epistemic aim of understanding is to be able to use that knowledge, in the form of theories, to derive predictions and descriptions of the phenomenon. In other words, the importance of understanding to science relies on the ability to use the theories one possesses.

Based on Franklin (1981), Nickerson (1985), and De Regt and Dieks (2005) accounts, the study of the concept of understanding has major implications on any area where the concept is used. Moreover, its impact on science is also of major consequence when referring to the use of theories. However, its significance to Engineering Management (EM) needs to be established.

A definition of what EM is or does as a discipline is still being formed. Lannes (2001) explains that EM is a twofold discipline focusing on managing engineering projects and applying engineering to management. Kotnour and Farr (2005) describe EM as a bridge between engineering and management. This bridge has, according to Kotnour and Farr, five core processes: strategic management, project management, systems engineering, knowledge management, and change management. There are areas of interest that are common to EM's core processes. Some of the most important areas of interest for engineering managers are complexity, learning, decision making, and problem solving. Yet, a common factor pervasive in all these areas that is of importance to EM is the concept of understanding.

In the study of complexity, Flood and Carson (1993, p. 24) state that "in general, we associate complexity with anything we find difficult to understand." Klir (1985) concurs with this position and states that "in addition to the common sense characterization of the degree of complexity as the number of interrelated parts, it also has a somewhat subjective connotation since it is related to the ability to understand or cope with the thing under consideration." This dependence on the individual to seeing problems as complex extends to engineering management and systems engineering. This is because in most cases decisions are made by a group of stakeholders.

When it comes to learning, problem solving, and decision making, the concept of understanding is also highlighted by different authors. In terms of learning and decision making, the process of understanding can be considered as the one that benefits the most with learning while contributing to decision making. Sterman (1994) remarks that we use learning to revise our understanding of the world and in so doing we affect the decisions we make. Perkins (1988) supports the idea of action supported by understanding by suggesting that we act out of our understanding of an activity. Nair and Ramnarayan (2000, p. 308) extend this position to problem solving by noting that "the definition of the initial state would reflect the individuals' understanding of the nature of the problem at the beginning, and the desired end-state would be described as the goal expected to be achieved by solving the problem."

Figure 1 shows how understanding contributes to these core processes by contributing to shared common areas of interest.

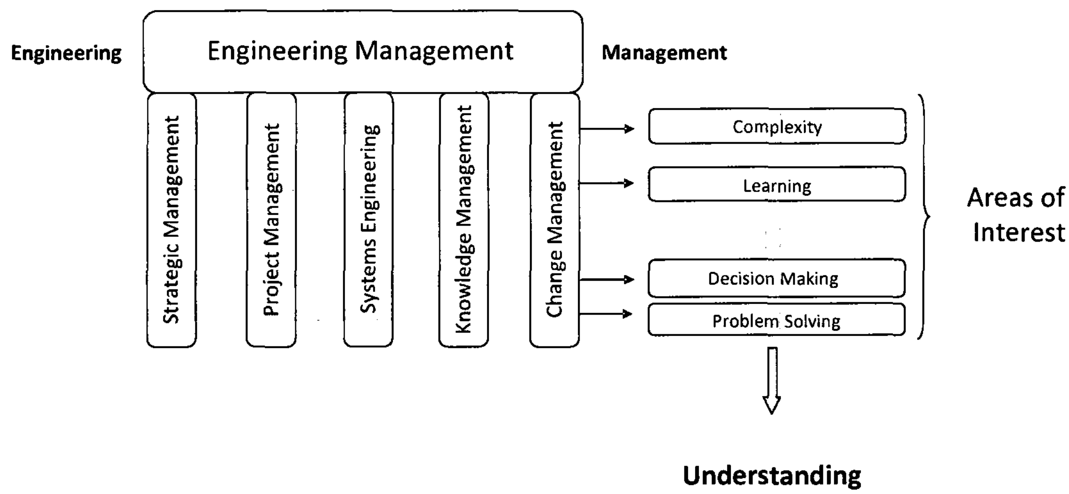

Figure 1. Understanding as a Common Thread in Engineering Management

Considering that the concept of understanding is of significance to Engineering Management, the following sub-section presents the proposed problem statement and research question.

1.3 PROBLEM STATEMENT AND RESEARCH QUESTION

The concept of understanding is described differently in varying contexts which is a consequence of the absence of a general theory of understanding. Consequently, a theory of understanding that explains the state of the art and contributes additional insights to the body of knowledge is needed. In order to generate such a theory, the following research question is presented:

What is understanding as it applies to not only objectively defined problems, but also to ill-defined problems?

In order to answer the research question, the following questions are addressed:

- What sub-constructs can be used to create a construct for understanding?
- How do these sub-constructs relate with one another?
- How can the process of understanding be bounded to study it independently from other cognitive processes?

This dissertation will provide:

- A definition of the concept of understanding.
- A construct that allows studying the concept in a structured manner.
- An initial theory of understanding based on the construct.

1.4 RESEARCH APPROACH

The research approach is focused on building theory out of existing theory. To do so, the body of knowledge on the concept of interest is reviewed and common thematic threads are obtained. Some of these threads correspond to underlying concepts that can be used to establish and define constructs to eliminate ambiguities from the body of knowledge. Other underlying concepts correspond to characteristics or conditions of the concept of interest. Underlying constructs and characteristics are put together forming an axiomatic structure which is a theoretical abstraction of the concept of interest. The theoretical abstraction, or meta-construct, is used jointly with proposed definitions to build the theory and explain the phenomenon of interest. Succinctly, the theory must say what the concept of interest is, what it does, and how it does it.

The resulting theory should not only be able to explain the existing concept of interest in the body of knowledge but also be able to generate new insight.

Through Modeling and Simulation (M&S) structure and formality are established via modeling and computational experimentation. More importantly, simulation provides data that can be analyzed for patterns showing emergence. Emergence is sought after given that it allows for theory discovery.

The resulting theory is also both the result of theoretical insight from the modeling process and from the experimental process. In other words, the theory should have insight resulting from the abstraction process, insight from the data, or both. The only two requirements of the theory are that it explains existing theory, to establish plausibility, and that it generates new insights to move the body of knowledge forward.

Besides the new insight provided, an important contribution of the theory should be the level of formality introduced by the M&S process. As Davis, Eisenhardt, and Bingham (2007) remark, simulation enhances theoretical precision while providing superior insight into complex theoretical relationships among constructs especially when empirical limitations exist. Further, they suggest that M&S can provide an analytically precise means of specifying assumptions. Figure 2 shows the defined approach.

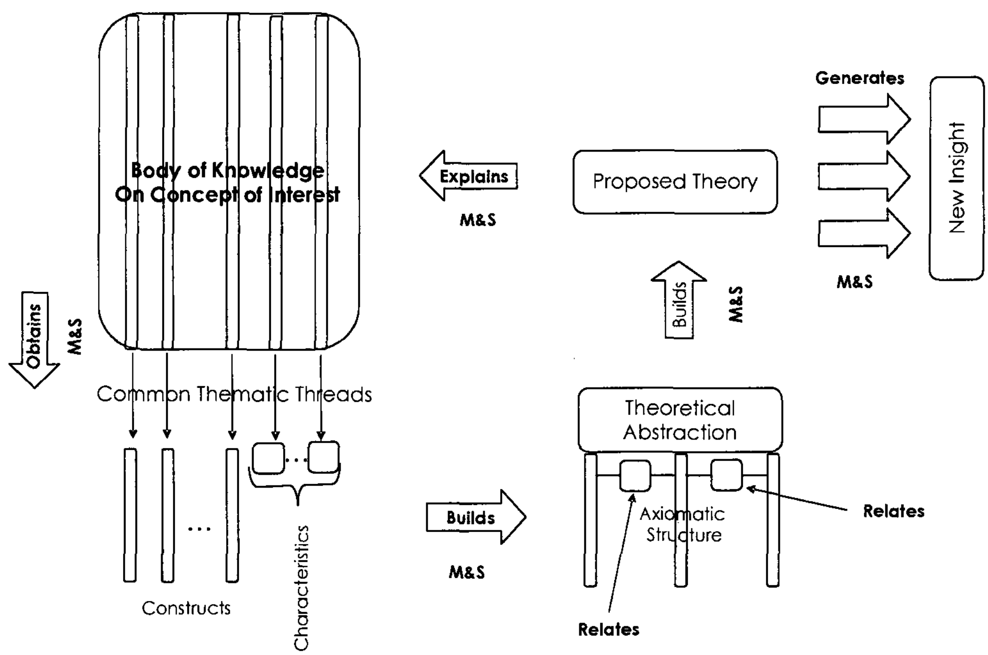

Figure 2. Research Approach

This proposed approach is an enactment of a methodology and method proposed by Sousa-Poza, Padilla, and Bozkurt (2008). In terms of methodology, they suggest theory creation from existing theories in the body of knowledge and not from observations, which makes the approach rationalist. In addition, generalizations from identified patterns in the body of knowledge are made instead of generalizations from observations. This makes the approach inductive. The generalization from existing theories towards theory building makes the underlying methodology rationalist and inductive as they name it. In terms of method, obtained premises from theoretical generalizations are put together in a system of premises where assumptions are made explicit. A structured system of premises is established using modeling. Through simulation, an experimental setting is established and new theory is discovered. This approach is based on the traceability of the resulting theory to the body of knowledge as a form of validation of the theory. If a premise is not found in the literature or drawn from it, it is discarded. This allows for the not inclusion of preconceived ideas and/or misconceptions about the phenomenon of interest. As mentioned, Sousa-Poza et al. 's methodology is grounded on philosophical tenets, reason why it is considered within the proposed approach. In terms of method, Sousa-Poza et al.'s method is consistent with methods provided in the literature (Mitroff, Betz, Pondy, & Sagasti, 1974; Reiner, 2007; Davis et al., 2007; Gilbert, 2008) that rely on modeling and simulating a phenomenon. However, what the proposed research approach provides is fine-tuning these methods by being more specific about steps and results from those steps while still being grounded methodologically. Figure 3 shows the Rationalist/Inductive Methodology and Method.

METHODOLOGY	METHOD
Exploration & Selection	Problem Identification
	Context Identification
	Context Selection
Rationalist Structuration	Modeling Technique Selection
	Model Development & Execution
	Testing Rules, Context & Conditions
Conclusion	Interpretation
	Conclusion

Figure 3. Rationalist/Inductive Methodology (Adapted from Sousa-Poza et al., 2008)

1.5 DISSERTATION ORGANIZATION

The Introduction presented an overview of the dissertation that highlights the problem, the approach, and the proposed solution.

The rest of the dissertation is organized as follows.

Section 2 presents the literature review on understanding which shows that there is no agreed definition of understanding beyond the one reflecting the idea of grasping something or a description of the concept. The review identifies knowledge, worldview, and problem as the main components of understanding, and appropriateness, process/output, time, and degrees of understanding as its main characteristics. Section 2 also shows the importance of disassociating not only understanding from output and process perspectives but also from processes such as learning and problem solving.

Section 3 presents the research approach. The approach relies on methodological and methodical underpinnings. At the methodological level, the research builds on an axiomatic structure based on premises derived from existing theories related to understanding. Methodically, Modeling and Simulation (M&S) is used to provide a way to make explicit premises and assumptions in a computable form. The model is implemented as an agent-based model and simulated to explore the concept of understanding. The results of the simulation are generalized and incorporated into the theory. The theory is used to explain understanding as it is found in the body of knowledge and to provide new insights into what understanding is and how it works.

Section 4 presents a review of the constructs of knowledge, worldview, and problem. This review shows that, just as the concept of understanding, these terms are loaded with ambiguity as well. The characteristic of appropriateness is explored based on the literature of areas such as decision making, system of systems engineering, and psychology.

Section 5 proposes definitions for knowledge, worldview, and problem. These definitions serve as the basis to define understanding. Definitions of understanding are the starting point towards a general theory of understanding (GTU). From the three underlying constructs, the Understanding Construct (UC) is built. This construct is used to establish three schools of thought or types of understanding. Two of these types of understanding are found in the body of knowledge, while the third is new.

Section 6 presents implications derived from the GTU. Theoretical and data generated implications for the study of understanding and for Engineering Management are presented.

Section 7 presents conclusions and future work.

2 LITERATURE REVIEW

2.1 UNDERSTANDING UNDERSTANDING: BACKGROUND RESEARCH

2.1.1 INFORMAL DEFINITIONS OF UNDERSTANDING

De Regt and Dieks (2005) remark that, many authors claim that scientific explanations are the means to achieve understanding, but none of them provide an account of what understanding is. Understanding is commonly and informally used in many different contexts and rarely due effort is given to properly define the concept. This informality has led to different uses of the word, all of them correct but insufficient to build a formal definition of the concepts. Some of the many uses of the word understanding are:

- As a verb to highlight a need: to aid students' understanding of scientific explanations (Mayer, 1989).
- As a verb to highlight intelligence: you can probably get a machine to do a task requiring intelligence, but if it does not understand the task, then it is not really intelligent (Klahr, 1973 p. 300).
- As a verb to highlight complexity: in addition to the common sense characterization of degree of complexity as the number of interrelated parts, it also has a somewhat subjective connotation since it is related to the ability to understand or cope with the thing under consideration (Klir, 1985).
- As a noun to highlight the importance of something: designing an appropriate set of command arrangements for coalition peace operations requires a clear understanding of the essential functions to be performed and the qualities desired-the objective criteria for success (Alberts & Hayes, 1995 p. 83).
- As a noun and as a verb to highlight a purpose: "if understanding is a primary goal of education, an effort to understand understanding would seem to be

an obligation, even if one is convinced that is likely to be only a partially successful effort" (Nickerson, 1985).

The previous usages of the word understanding depart from its dictionary definition. Dictionary (2009) defines understanding as "grasp the idea of." Webster Online (2009) defines understanding as a "mental grasp." These definitions reflect two aspects of understanding: the *state* of having grasped something and the *process* of grasping something. These two perspectives are further explored in the following review.

The areas of study of understanding, epistemology, cognitive science and education, and AI are presented as perspectives, namely, theoretical, experimental, and computational respectively.

2.1.2 UNDERSTANDING FROM A THEORETICAL PERSPECTIVE

Zagzebski (2001) sees understanding as the grasping of connections among pieces. She proposes that "understanding is the state of comprehension of nonpropositional structures of reality." This definition suggests that an explanation of what was understood can be seen as an output of understanding. This output is then the state when one has understood. Zagzebski states that understanding does not require knowledge and that falsities contribute more to understanding. Falsity, in her view, accounts for knowledge of abstractions. Given that all abstractions are simplifications and simplifications of reality are not reality then she does not consider them knowledge. This is regardless of how widely accepted those abstractions are. In Zagzebski's case, the use of "falsities" to understand a problem implies understanding those falsities. This is equivalent to saying that one understands about things when one understands falsities about those things.

Through a linguistic analysis, Franklin (1981) looked at the nature of the word understanding from two points: objective and subjective. Objectively, Franklin states that understanding, in the comprehensive sense as he notes it, is the "discernment of significant structure of a situation." Franklin adds that too much complexity and the structure cannot be grasped and so do not understand; too little and there is insufficient structure to be grasped. Subjectively, Franklin refers to wrongly understanding as an indication of "something like my lack of complete confidence in my information." Whereas the objective perspective refers to the state of understanding as a truthful discernment, the subjective perspective seems to refer to the state of understanding as an erroneous discernment. It is noted that Franklin does not explain what the "comprehension sense of understanding" means.

One issue raised by Franklin (1981) is the truthfulness, or validity, of understanding. Grimm (2008) presents two prevailing cases found in epistemology: the one that considers that understanding as a species of knowledge and the one that does not. This discussion, although focused on differentiating knowledge from understanding, brings the issue whether or not understanding has properties of knowledge; therefore whether or not it has a truth component. Zagzebski (2001) makes the case the truth is not required. Grimm, on the other hand, states that understanding cannot be had in the absence of truth. To this extent, Grimm requires observations of reality to be factive or true which is a requirement of knowledge. If this requirement is transferred to understanding, it suggests that one understands when something is known in the absolute, in other words, one understands problem P when one knows K about P.

The parallel exploration of the nature of understanding and knowledge and the requirement to know K (or falsities) to understand P (or things) is an account of understanding knowledge. This is confirmed by Franklin who states that when comparing knowledge with understanding, these comparisons "greatly illuminate our understanding of knowledge." In other words, when referring to understanding, Franklin, Grimm, and Zagzebski are referring to understanding of knowledge. In this case, know K to understand P is equivalent to understand K to understand P or understanding knowledge to understand a problem.

De Regt and Dieks (2005) further make this case when presenting that scientific understanding of phenomena requires theories to be understood. De Regt and Dieks state two conditions for scientific understanding: criterion for understanding phenomenon (CUP) and criterion for the intelligibility of theories (CIT). CUP is stated as: *A phenomenon P can be understood if a theory T of P exists that is intelligible (and meets the usual logical, methodological and empirical requirements).* Intelligibility of theories is addressed by the CTI that is stated thus: *a scientific theory T is intelligible for scientists (in context C) if they can recognize qualitatively characteristic consequences of T without performing exact calculations.* Both criteria rely on understanding a theory T. This can be phrased as *P can be understood if a theory T of P exists and is understood.*

2.1.3 UNDERSTANDING FROM AN EXPERIMENTAL PERSPECTIVE

Miyake (1986) does not define what understanding is; however, Miyake presents an experimental setting to capture understanding. This setting is based on the capability to establish what something does and how it does it via a mapping between what is not known about something and what is known. The resulting structure of that mapping is assessed by a framework called the function-mechanism hierarchy (Miyake, 1986). A function refers to the description of the task, the mechanism refers to how the task is done, and hierarchy refers to the need to have identified functions and mechanisms to explain functions and mechanism at a lower level. Miyake describes the process of understanding as the ability to identify functions and hierarchy. Miyake (1986) provides the idea of understanding through the point of view. In this case, she highlights that when one has difficulty understanding a problem, one needs to shift the point of view to solve the problem. This position on the point of view is analytical by nature in the sense that it is based on the objective decomposition of the problem in terms of elements and function among elements within a structure.

Nickerson (1985) does not explicitly provide a definition for understanding but makes an attempt to a definition. Nickerson states that:

> *Understanding is an active process. It requires the connection of facts, the relating of newly acquired information to what is already known, the*

> *weaving of bits of knowledge into an integrated and cohesive whole. In short, it requires not only having knowledge but also doing something with it.*

This definition highlights the idea of grasping something in the form of connecting something foreign (new information) to something familiar to us (knowledge) cohesively. This definition, as Miyake's description, refers to the process of understanding but makes no reference to the state of understanding. Nickerson (1985) takes experimental data from studies of misconceptions in physics for studying understanding. In this case, the setting is made of students who have had formal training in physics who do not understand relatively fundamental principles of projectile motion. He suggests that not only lack of understanding can be studied through the testing and attainment of incorrect answers by students but also that lack of understanding is a function of strong preconceptions and misconceptions.

Perkins (1988) presents that understanding involves knowing how different things relate to one another in a web of relations: what the something is for (thing-function relation), how it works in various ways (function relations) and where it comes from (cause-effect relation). The relation concept from Perkins is certainly close to the idea of function of Miyake (1986) and of Nickerson's (1985) web-like behavior as the capability of understanding of inferring the behavior of a system based on the cause-effect relationship among its components. *Coherence* within understanding refers to how something is placed within a web of relations as a measure of adequacy and how they relate to the world outside an organism (Perkins, 1988). This can be seen as equivalent to the concept of cohesiveness presented by Nickerson (1985). However, just as Nickerson states, the idea of coherence is still open to interpretation. In understanding and *standards of coherence*, Perkins highlights the dependence of understanding on context by providing an example of the importance of standards in poetry and physics. Poetry, Perkins remarks, is full of paradoxes, in the sense of symbolisms, whereas this practice is not acceptable in physics. Physics requires the rigor of science as standard and leaves little space for interpretation. Poetry, on the other hand, has a subjective standard and leaves plenty of room for personal interpretation. In understanding and *generativity*, Perkins presents the case when memory may play a deceiving role in understanding; just because one knows does not mean one can apply that knowledge. The need of *applying* knowledge arises and just knowing the web of relations may not be sufficient. Finally, in understanding and *open-endness*, Perkins presents the case of the human incapability in knowing all there is to know and all possible relations in certain contexts. A web of relations is limited even as the web grows and the most that can be said is that some things are understood about it adequately for certain purposes. Perkins (1988) provides the idea of a holistic perspective or *holistic looking* as a way to understanding. Perkins remarks that too much analysis can be counterproductive when understanding art given that the process of appreciating art can be spoiled. However, Perkins does not call for the complete elimination of an analytical perspective when understanding art such as the case of understanding color relations.

Miyake (1986), Nickerson (1985), and Perkins (1988) focus on describing understanding from a problem perspective. However, they are referring to the *understanding of knowledge through knowledge application.* Further, they rely on a solution to assess understanding. If a solution is provided and the problem is solved, then the evaluator confirms that the person understood the knowledge applied to the problem. Nickerson and Perkins provide the best example. In their examples, a person knows physics when knowledge of physics is properly applied to problems of physics.

2.1.4 UNDERSTANDING FROM A COMPUTATIONAL PERSPECTIVE

According to Klahr (1974) a machine is intelligent if it shows understanding. Creating machines that resemble intelligence, or that show understanding, has been the goal of Artificial Intelligence (AI) since its inception.

Moore and Newell (1974, p. 203) provide a criterion for understanding as: "S understands knowledge K if S uses K whenever appropriate." This criterion contains five elements: two old, one paradigmatic, one of subjectivity, and one of opportunity. The first old element, presented by Nickerson (1985) and De Regt and Dieks (2005), is the use of knowledge or theories; the second old element, represented by the appropriateness of the use of knowledge which resembles the standard of coherence presented by Perkins (1988); the paradigmatic it refers to understanding a task when knowledge has been understood; the one of subjectivity refers to S; and the one of opportunity refers to the timely application of knowledge or whenever.

The use of knowledge, as suggested, is similar to the idea of connecting newly acquired information to what is already known of Nickerson (1985) and the existence of intelligible theory T of P of De Regt and Dieks (2005). From this it can be said that knowledge is needed to be able to understand a task. The idea of appropriateness refers to how close the task is to the knowledge used suggesting the possibility of partially understanding. The paradigmatic element refers to understanding a task when knowledge is understood. This is key to the AI community where one of the main goals is knowledge representation towards working on a particular task. Moore and Newell (1974) suggest that for a system to understand a process an act of assimilation should take place. This act of assimilation is the construction of maps between structured knowledge of the system and the structure of the task. This process, they present, is what makes the system understand: bringing its *relevant knowledge to the task.* This position suggests that not only does the task need to be structured but also knowledge has to be structured as well.

In Moore and Newell's account when referring to understanding of S, the idea of subjectivity of De Regt and Dieks (2005) and Perkins is present. This idea reflects a human or computer agent that creates the possibility of different understandings of the same task. Finally, the idea of time or opportunity when Moore and Newell (1974) refer to "whenever" is of importance. It seems that "whenever" reflects a time lapse when understanding is bound to occur which may be a characteristic of the task or a self-impose condition of the human or computer agent.

Ören, Ghassem-Aghaee, and Yilmaz (2007) present a taxonomy of the word understanding based on the use of the word in different contexts. However, they do not define what understanding is. Instead, they describe the process of understanding based on three conditions. They posit that a system ***A*** can understand an entity ***B*** (Entity, Relation, Attribute) if and only if:

- ***A*** can access ***C***, a meta-model of ***B***s (***C*** is the knowledge of ***A*** about ***B***s);
- ***A*** can analyze and perceive ***B*** to generate ***D*** (***D*** is a perception of ***B*** by ***A*** with respect to ***C***);
- ***A*** can map relationships between ***C*** and ***D*** for existing and non-existing features in ***C*** and/or ***D*** to generate result (or product) of understanding process.

These criteria present an account of what understanding is based on the ability of a system to understand. It is, however, the same paradigmatic view of Moore and Newell (1974) in that it focuses on the formulation of knowledge (C being the meta-model of B) assuming a structured task. It differs from Moore and Newell's description in that the mapping is not one between task and knowledge but between a perception of the task and the knowledge base. It can be speculated that this variation is due to today's machine's capability of using sensors. This capability was not as prevalent in 1974 when inputs were inputted directly into a computer. However, if there are different systems with the same knowledge, about the same task, Ören et al. suggest that all perceptions of the task will be the same and more likely the mapping will be the same. This is valid in systems where repeatability and objectivity is desired, but fails when different human agents can have different understandings based on the same task.

Ören et al. (2007) provide insight considering understanding as a process. They identify steps (sub-processes of the overall process) and elements that are part of that process. The basic element mentioned is the knowledge base. The main steps reflect the capability of accessing a knowledge base, analyzing and perceiving of task (amenable to analysis) plus the capability of generating, storing, and mapping a perception. Finally, Ören et al. (2007) name the output of the process of understanding as *result*. This result is crucial in understanding because it provides an idea of what understanding does. However, Ören et al. do not expand on this topic.

2.1.5 DISCUSSION ON THE THREE PERSPECTIVES

Franklin (1983), Grimm (2008), and Zagzebski (2001) depart from the definition of understanding as 'grasping,' although they focus on describing understanding from a knowledge perspective. Furthermore, they seem to be referring to the *understanding of knowledge to understand a problem*. Franklin, for instance, says that a problem is understood when the structure of the problem is known. This requires understanding one's knowledge about the structure. When one's knowledge is understood, then it can be said that the structure is "discerned." Zagzebski's case is equivalent to Franklin's considering that one understands about things when one understands falsities about those things. It is also Grimm's case where truthfulness of understanding is established through the truthfulness of the knowledge used which is equivalent to say one understands about things when one knows how things stand in the world. The three authors focus on the state of understanding as the moment when an explanation is provided or a structure has been discerned.

Miyake (1986), Nickerson (1985), and Perkins (1988) share the common assessment that no major effort has been done towards defining understanding. They focus on describing what understanding entitles. Further, they work under certain conditions or assumptions:

- There exists a bounded and structured problem. The structure of a problem is identifiable and knowable.
- There exists an identifiable sequential process to capture that structure.

- A solution can be formulated and evaluated through action and via feedback assess amount and quality of understanding.
- Most importantly, they all refer to the *understanding of knowledge through knowledge application to a problem*, in this case, problem solving.

This list, especially the last bullet, reflects a school of thought. This school of thought describes understanding as understanding of knowledge. This paradigm explains the need for a bounded problem with an existing solution. This requirement allows the evaluator to prove that the person being evaluated knows its knowledge and how well it was used. For instance, a person is given a problem in the form of a question: 2+2=? If the person answers 4, the problem is solved, and it is concluded that the person understood. Yet, what the person understood was the knowledge of addition given how it was used to solve the problem. The three authors also focus on the state of understanding as the moment when a solution to a problem is provided.

It is noted that the schools of thought of *understanding-of-knowledge-to-understand-a-problem* from the theoretical perspective and *understanding-of-knowledge-through-knowledge-application-to-a-problem* from the experimental perspective are equivalent in that both reduce to understanding knowledge. In the first case, understanding of knowledge is used to reason about a problem. In the latter case, understanding of knowledge is used to provide a solution. In both cases, knowledge is applied to a problem and when the problem is well-reasoned or solved it is said that the person understood.

Computational researchers, unlike theoretical and experimental ones, focus on identifying criteria that capture the process of understanding. In addition, computational researchers, like their counterparts, do not define understanding.

Moore and Newell (1974) and Ören et al, (2007) refer to understanding when *understanding a task when knowledge is structured.* This school of thought relies on the idea of an already objectively defined task that displays a structure. It also relies on the idea that knowledge can be structured and that a unique mapping, between knowledge and task, is possible. In other words, knowledge is already understood and the task is already structured. All that is needed is to map knowledge to a problem. These conditions can be achieved under well-defined and bounded cases, but not under ill-defined ones.

Referring back to the 2+2 example; whereas the previous school of thought wanted to know if the person understood addition, in this school of thought addition is already known. Moreover, it is known that 2+2=4. What it is then required is to know if the knowledge of addition is properly used in a task or not.

The three perspectives present one major assumption, ambiguous attempts to definitions, and different confounded terms.

The objectivity assumption is common to all three perspectives. The idea that one can objectively establish understanding when a structure of a problem is identified (Franklin, 1981; Miyake, 1986) is prevalent. In Miyake's case, for instance, it is assumed that a function exists and it is the correct one. Similarly, the definition assumes that there is one and only one hierarchy which eliminates other kinds of dependencies between functions and parallel structures. Furthermore, the definition assumes an equivalency of functions and structures. The objectivity assumption leads to correlate difficulty of establishing a structure with complexity. Although there is no denying that something inherently more complex may be more difficult to understand, linking understanding with a structure is deceiving in the sense that complexity may be present in a simple structure. Seemingly simple structures when presenting emergence are more complex than non-emergent large structures. The objectivity assumption also leads to the assumption that it is possible to validate the outcome of the process of understanding. In other words, the process of understanding always yields an explanation that can be validated via comparison with an existing solution or through solving a problem. However, the testing and attainment of correct answers is misleading. This approach, while seeking a way of assessing one's understanding by comparing what was understood to a known solution, does not consider the case where there is no solution and does not consider that correct answers may be due to either the use of memory or the result of a guess.

A departure from the objectivity assumption was suggested by Perkins (1988) when considering the open-ended, context dependence, and holistic looking of understanding. This departure is echoed by Moore and Newell (1974) premise of human or computer agent that creates the possibility of different understandings of the same task. Both accounts suggest the idea of degree and subjectivity of understanding. Subjectivity in this context deviates from the subjectivity characterization provided by Franklin (1981) in that it is not about wrong understanding, but about incomplete understanding. Incomplete understanding also deviates from the idea of absolute and truthful explanation of reality proposed by Grimm (2008) as this account is based on knowledge. However, despite the departure from the objectivity assumption, the idea of structure still remains. In Perkins' case, the idea is observed when referring to *relationships among elements of a phenomenon* (*relations, coherence, and standard of* coherence characteristics). In Moore and Newell case, the idea is observed when they seek to structure knowledge to apply to an already structured task.

Ambiguity in its use has also made difficult the study of understanding. Franklin (1981), Nickerson (1988) and Zagzebski (2001), for instance, provided definitions of understanding. However, they do not elaborate on their definitions or use confusing terms. Franklin's account refers to discernment as it relates to the "comprehension sense to understand." Franklin does not expand on the relation between understanding and comprehension, defined comprehension, or even acknowledge that comprehension is widely used as a synonym of understanding. Comprehension is also part of Zagzebski's account. Like Franklin, there is no definition of comprehension or account on how it relates to understanding. Nickerson's attempt to a definition brings ambiguity as well. He relies on definitions that are open to interpretation, namely knowledge, information, cohesiveness, and the differentiation between newly acquired information and existing knowledge. The notion of a cohesive whole is also ambiguous as the definition does not specify how to evaluate cohesiveness and most importantly to whom the whole is cohesive.

Confounding terms limits the study of understanding by not differentiating it from concurrent processes. The most common processes are perception, problem solving or decision making, and learning. For instance, computational researchers rely on perception to understand. Although there is no denying that perception is important to capture reality it does not necessarily mean it is part of the understanding process. Ergo, when studying understanding in terms of perception, it cannot be differentiated if insights are about perception or understanding. Franklin (1981) makes the case of confidence on information. Confidence in information is a problem solving issue more than an understanding issue (Tallman, Leik, Gray, & Stafford, 1993). Miyake says that the process of understanding relies on feedback after action is taken to improve understanding. In the literature, feedback due to action is defined as learning (Sterman, 1994).

This discussion shows that in the literature there are accepted assumptions and preconceptions which have not been challenged. Additionally, an effort to define understanding has not been taken. The main assumption is that that understanding is objective and follows structure. This assumption implies that there are objective ways to objectively evaluate understanding. As mentioned, these assumptions leave out the possibility that understanding can be subjective and unable to be assessed due to the ill nature of problems being understood. A widely held preconception is that that the process of understanding is embedded with other processes. This limits the ability of explaining what understanding is given that one could be referring to learning, for instance, instead of understanding. To compound the mixing of understanding with other processes, there are not accepted definitions of understanding beyond the idea of grasping. Mostly, there are descriptions of understanding and when describing it, not only descriptions of the concept are ambiguous, but the terms used to describe it are also ambiguous.

This discussion also presented the existence of two schools of thought of understanding: one based on understanding knowledge, the other based on understanding a task. Both schools of thought are neither recognized by the disciplines that espouse them nor acknowledged by one another. This leads to ambiguity given that when talking about understanding it is assumed all people involved are talking about the same type of understanding. The schools of thought show that it is not the case.

2.1.6 UNDERSTANDING'S COMMON THEMATIC THREADS

From these schools of thought, common thematic threads are identified. These threads are reflected in components and characteristics of understanding. The identified components of understanding are:

- *Knowledge* or that used to understand a problem.
- *Point of View, or worldview,* also used to understand a problem, but its role needs to be explored and differentiated from that of knowledge.
- *Problem* or that what needs to be understood.

Figure 4 shows the components of knowledge, problem, and worldview and implicitly suggests a relation among them. The way these components are related should reflect the appropriateness of that relation, how they relate should reflect a process, and the result of that relation should reflect what understanding does.

The identified characteristics of understanding are:

- *Appropriateness* which seems to be a condition for understanding that needs to be explored.
- *Process* and *output* as the two perspectives that tell us what understanding is and what it does.
- *Timing to understand* seems to be an issue which needs to be explored.
- *Degree of understanding* needs to be explored as well.

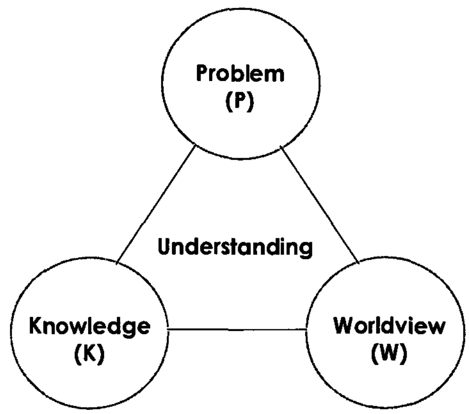

Figure 4. Components of Understanding

2.2 PROBLEM SITUATIONS

Problems where the objectivity assumption does not have certain characteristics, among them:

- There are many participants.
- No consensus on the definition of the problem.
- No known solutions.
- The effects of proposed solutions are intractable.

These problems are called problem situations.

When problems are not agreed upon, but still are perceived as problems by some, they are called problem situations. Vennix (1996, p. 13) posits the nature of these problems as:

One of the most pervasive characteristics of messy problems is that people hold entirely different views on (a) whether there is a problem, and if they agree there is, (b) what the problem is. In that sense messy problems are quite intangible and as a result various authors have *suggested that there are no objective problems, only situations defined as problems by people.*

Further, given that problem situations don't have an identifiable and unique solution, the process of validating understanding or the evaluation of understanding through the evaluation of a solution is not possible. To further make this case; a paradox is presented:

Paradox 1. Understanding a problem does not depend on the existence of a solution
If we start with the premise that understanding the problem is to have a solution and to have a solution is to have understood the problem we reach a tautology that says that understanding depends on understanding or that solutions depend on solutions. Second, if the tautology is accepted, can the following question be evaluated: can you understand that a solution is that there is no solution?

- *If we answer yes to the question, at the very least, understanding must have taken place for me to be able to say that no solution was indeed a solution. Further, if a solution is the test case for understanding, then there cannot be no solution. Given that a solution is demanded for me to show that I understood, no solution is not an acceptable solution.*
- *If the answer to the question is no, then a solution must exist which excludes me from understanding problems that have no solution. In other words, when a solution is demanded and no solution is the solution, we are left with no possibility to understand given that no solution was discarded as the solution.*

Given that both no solution and solution can be used to understand a problem, then having a solution is not part of understanding.

This paradox shows that understanding does not depend on a solution in the general case. A solution is part of understanding, if and only if, it always plays a part in the process. In other words, understanding would not be able to occur without having a solution, which is not the case as previously presented. However, understanding can be validated through a solution in the particular case where there exists a solution, as Miyake (1986) presented it. It is important to note that given that understanding does not depend on the validation of understanding, the only way one might assess understanding is when there is a claim that one understands. Ergo any action, depending on enacting a solution, taken as a consequence of what was claimed to be understood must be validated as a separate process.

Finally, given that the focus of this dissertation is on the individual, the concept of problem situations collapses to a case of problem or no problem. However, if for an individual there is a problem, it is not an objectively defined problem. In other words, even for an individual there is not a unique way of defining the problem. Further, there is not a known solution to assess correctness on what was understood. Having said this, from this point on referring to problem situations implies the presence of more than one individual. Referring to a problem implies the presence of one individual with a problem that has characteristics of problem situations.

2.3 SUMMARY OF LITERATURE REVIEW

This section provides a review of the literature on the concept of understanding. There are three main areas of study, or perspectives, of understanding: theoretical, espoused by studies in epistemology; experimental, espoused by studies in cognitive science and education; and computational, espoused by studies in AI. From these three perspectives, two schools of thought of understanding emerge: understanding of knowledge through the application of knowledge and understanding of a task through structuring knowledge. From these two schools of thought, the use of the term "understanding" is ambiguous and it bears many assumptions. The main assumption is that a problem can be objectively defined and that there exists a solution to assess what was understood. From the two schools of thought common thematic threads are also observed. These thematic threads are in the form of components of understanding -

knowledge, worldview, and problem - and characteristics of understanding - appropriateness, process/output, time, and degree. Lastly, the concept of problem situations was used to establish the general case of understanding.

Figure 5 shows a graphical review of section 2.

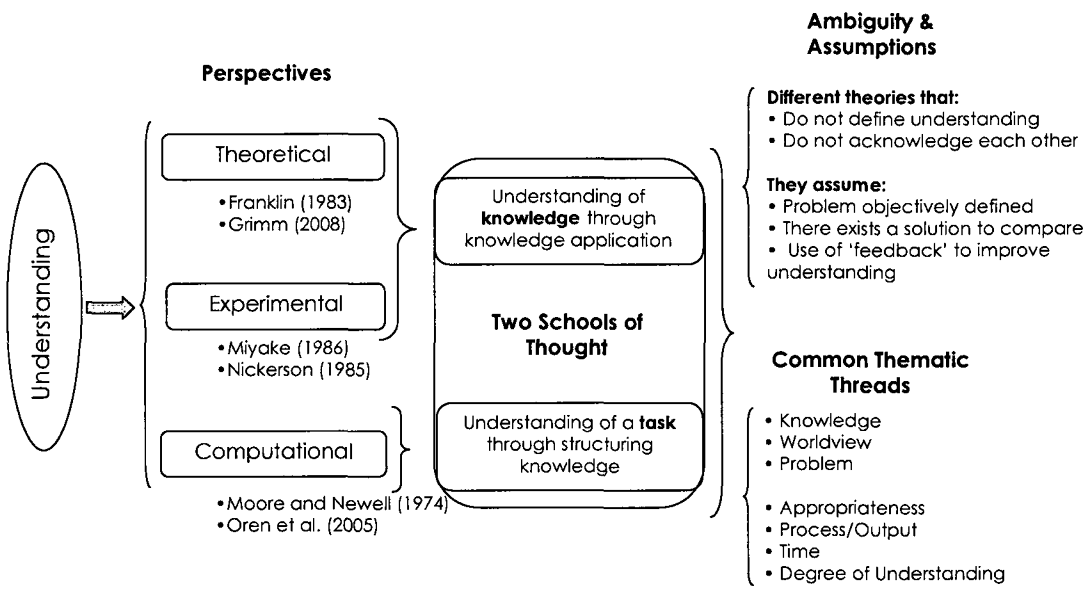

Figure 5. Literature Review

3 DERIVING A CONSTRUCT FOR UNDERSTANDING

3.1 ON KNOWLEDGE

Figure 6 shows how the concept of knowledge has been addressed in this review.

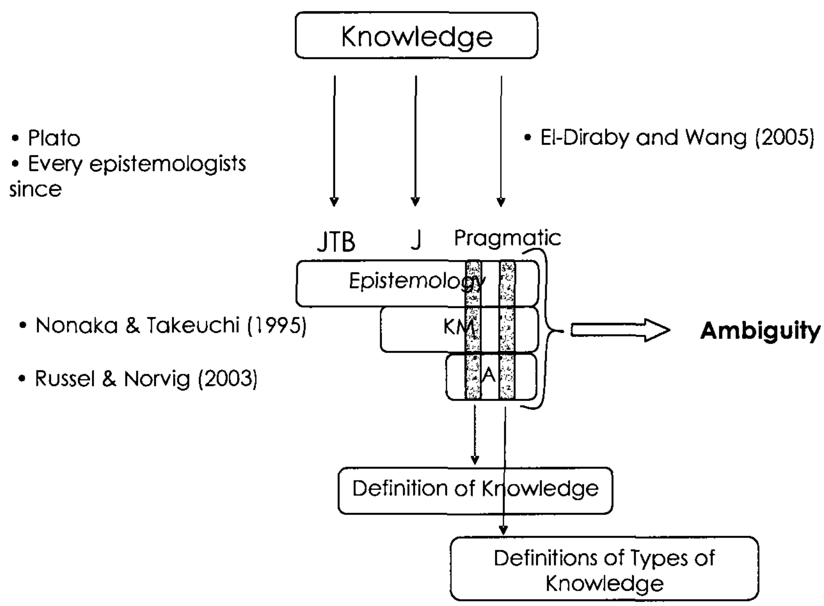

Figure 6. Review on Knowledge

Knowledge, as a concept, can be traced back to the ancient Greeks with Plato in 360 BC. In his dialogue, Theaetetus (Plato, 1999), he explores the nature of knowledge. Today, epistemologists still struggle with a definitive definition of knowledge.

Plato defined knowledge as justified true belief (JTB). This definition of knowledge has two key components: truthfulness and justification (J). Truthfulness relies on the idea of an absolute truth on an objective reality. This position requires the idea of an objective reality upon which absolute truth can be established. This is not necessarily attainable in most real life conditions. Justification is also a matter of debate. Franklin (1981) presents that:

> *Apart from the renewed skeptical doubts as to whether and how adequate justification could ever be achieved; there are challenges to the adequacy of the standard account itself.*

In all, these conditions of truthfulness and justification are not necessarily abided by. The difficulty of studying reality forces us to work with models and abstractions of reality. These abstractions are not reality ergo any outcome is not truthful in the epistemological sense, therefore according to epistemologists' position is not knowledge.

Two more contemporary accounts of the definition of knowledge are found in the Knowledge Management (KM) literature. Nonaka and Takeuchi (1995, p. 58) present knowledge as the "dynamic human process of justifying personal belief toward the 'truth'." Nonaka and Takeuchi's definition falls in the category of justifying true beliefs. It was shown that this position presents the difficulty of establishing a standard for justification. El-Diraby and Wang (2005) present a more pragmatic definition of knowledge. They posit that knowledge "consists of facts, truths, and beliefs, perspectives and concepts, judgments and expectations, methodologies and know-how." This basically says that knowledge is everything in our minds. Possibly this is because in most cases, an individual may not be able to assess what is knowledge or not knowledge.

Pears (1971) presents two challenges of a definition of knowledge. First, he focuses on its recursive nature. Pears (1971, p. 4) posits, "If I know something, I ought to know that I know it, and know that I know that I know it? Where will this stop? Second, Pears (1974, p. 1) asks a question for which he does not provide an answer. He posits:

> *For instance, what is the opposite of knowledge? Is it simply not knowing something and not even thinking that one knows it, or is it thinking that one knows it when one does not? And, whichever it is, what is not knowing? Is it the mental void that a person feels when he has no idea*

> *what the answer to a question is? Or is it something more positive than this? Perhaps he has an answer, but it may be a false one. Or maybe it is true, but only a lucky guess.*

Pears (1971), however, posits an interesting definition for factual knowledge. He remarks that factual knowledge is a statement that cannot be a guess. This definition does not abide by the conditions of JTB, so the requirements of truthfulness and justification are not checked. It just requires knowledge to be stated without guessing. This definition seems to be more in line with El-Diraby and Wang (2005) in that it is pragmatic in nature. Pears' definition also seems to be in line with that of the artificial intelligence (AI) community. From an AI point of view, knowledge is programmed to a computer in a form of statements in a rule base (Rusell & Norvig, 2003; Negnevitsky, 2005). It is noted from figure 12 that the studies of AI and KM are extensively based on epistemology.

Pears (1971) suggests a characterization of knowledge as factual. This characterization is also found across bodies of knowledge. In the KM community, as presented by Rowley (2000), Nonaka and Takeuchi (1998), and Nonaka, Konno and Toyama (2001), knowledge is seen as explicit and tacit.

Explicit or "codified" knowledge is factual knowledge that can be easily expressed with symbols. Symbols can be represented in written words, drawings, equations, or pictures and can be conveyed in a systematic way (Nonaka et al., 2001; Nonaka & Takeuchi, 1995; Allee, 1997). At the very moment something is being expressed, it becomes an explicit form of knowledge. Conversely, tacit knowledge is more related to sensorial acquired information, individual perception, intuition, and personal experience (Nonaka et al., 2001; Ford & Sterman, 1997). It centers on mental models an individual carry internally. Those models can be concepts, images, beliefs, viewpoints, value sets, or guiding principles that help people define their world (Allee, 1997). Sternberg, Wagner, Williams, and Horvarth (1995) remark: "it is called tacit because it is inferred from actions or statements."

The concepts of explicit and tacit knowledge are consistent with declarative and procedural knowledge proposed in psychology by Anderson (Anderson, 1995). Anderson posits:

> *Declarative knowledge is represented in units called chunks and procedural knowledge is represented in units called production rules. The individual units are created by simple encoding of objects in the environment (chunks) or simple encodings of transformations in the environment (production rules).*

Anderson's characterization is widely used in AI (Russel & Norvig, 2003).

Another perspective on the same discussion is one proposed by Ryle (1949). Ryle characterizes knowledge as knowing that and knowing how. This characterization is consistent with both, declarative/procedural and explicit/tacit knowledge. Knowing that relates to the theoretical context of content and facts while knowing how to the practical knowledge of actually doing things (Franklin, 1981).

It can be seen that a universally accepted definition of knowledge does not exist. This leads to different uses of the terms under different contexts, which leads to ambiguity. The same applies to the characterization, or types, of knowledge. In order to use knowledge as a construct in this work, a definition needs to be presented. The same applies for the characterization of knowledge.

3.2 ON WORLDVIEW

Miyake (1986) and Perkins (1988) made the case of point of view, either analytic or holistic, when referring to understanding. Miyake says that an objectively defined problem must be seen from a different vantage point if difficulty in understanding arises and Perkins mentions holistic understanding as a way to understand art without analysis, seeing something aesthetically and not by its individual components. The way a problem is viewed/perceived is due to the lens of the observer. This lens is called worldview.

Figure 7 shows how the concept of worldview has been addressed in this review.

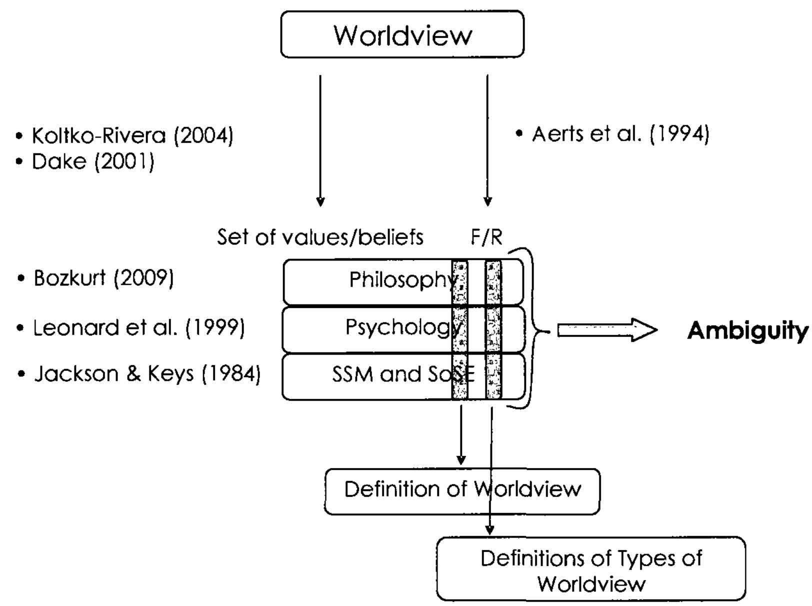

Figure 7. Review on Worldview

Worldview has been defined both as a set of values and beliefs and as a frame of reference (F/R). According to Koltko-Rivera (2004):

> *Worldviews are sets of beliefs and assumptions that describe reality. A given worldview encompasses assumptions about heterogeneous variety of topics, including human nature, the meaning and nature of life, and the composition of the universe itself.*

Dake (1991) posits that worldviews "entail deeply held beliefs and values regarding society, its functioning, and its potential fate". Aerts, Apostel, De Moor, Hellemans, Maex, Van Belle, and Van der Veken (1994, p. 9) present world view as "a system of co-ordinates or a frame of reference in which everything presented to us by our diverse experiences can be placed."

From these definitions it can be established that worldview helps individuals describe reality, and this description of reality assists them processing their surroundings. How reality is described and how individuals learn about it is found in philosophy in the form of ontology and epistemology. Keating (2008) presents that worldview, or *weltanschauung*, is based on philosophical underpinnings, namely ontological which is concerned with the nature of reality epistemological which is concerned with how knowledge is communicated.

Keating (2008), by presenting worldview as ontological and epistemological, provides a characterization of worldview. This philosophical characterization of worldview is consistent with Bozkurt, Padilla, and Sousa-Poza (2007) and Bozkurt (2009). The difference with the latter two works is that they add a teleological component and the ontological and epistemological spectrums have different ends (Process and Substantive instead of Realism and Nominalism and Empiricism and Rationalism instead of Positivism and Antipostivism respectively). The teleological component is mentioned in Keating (2008) as "the perspective of SoS and drives purposeful decision, action, and interpretation," but it is not described as teleological. An epistemological worldview would show how an individual seeks knowledge or uses knowledge. Nonaka and Takeuchi (1985) suggest that along an epistemological dimension, explicit and tacit knowledge sit at the extremes; in other words, an individual relies on its explicit/tacit knowledge to describe reality. Keating (2008) posits that an ontological worldview shows the individual as part of reality (Nominalism) and external of reality (Realism) when describing reality.

Worldviews have also been studied in psychology, not from the point of view of describing reality as Koltko-Rivera (2004), Drake (2001), and Aerts et al. (1994) present, but in terms of perceiving reality. Carl Jung's theory of psychological traits (Jung, 1968) and its evolution into the Myers-Briggs Type Indicator (MBTI) attempt to capture, among other things, how individuals perceive reality and how they make decisions. The focus in this case is on ontology.

An ontological worldview show how an individual perceives and explains reality. Rescher (1996) says that a person can see reality as individual elements (substantive reductionist approach) or as a collection of elements (process holistic approach). Leonard, Scholl, and Kowalski (1999), under their scale of perception, describe sensing and intuition as forms of perceiving reality. Leonard et al.'s (1999) definitions of sensing and intuition adhere to Jung's definitions; *sensing*, "which transmits a physical stimulus to perception", and *intuition*, "which transmits perception in an unconscious way." Leonard et al. however, propose their own characterization on perception as field dependence/independence. Field dependence "is the ability to separate an object or phenomenon from its environment." An individual with field independence prefer detail and basic relationships when solving problems, whereas a field dependent individual prefers intuitive approaches to solve problems. While field dependent individuals are less inclined to separate objects from the environment, field independent individuals tend to differentiate objects from environment concepts (Leonard et al., 1999). One difficulty with these characterizations is the definition of intuition. Klein (1998) suggests that intuition is the recognition of patterns, or lack thereof, in the surrounding environment without necessarily identifying the underlying structure that generates them. Further, these patterns are identified when the individual is placed in particular contexts. In this sense, given that Nominalism and field dependence depend on an individual immersed in her/his surroundings, intuition must play a role in her/his perception of reality under those conditions.

Research in systems theory, Soft-Systems Methodology (SSM) and system of systems engineering (SoSE), has used the ontological separation of reductionist and holistic as posited by Rescher (1996) as a characterization of worldviews. Reductionism, related to machine-age systems, involves the independent study of fully observable passive parts within a closed system. Holism, on the other hand, involves the simultaneous and interdependent consideration of parts to study a system (Jackson & Keys, 1984).

Just as with knowledge, there is no universally accepted definition of worldview. This leads to different uses of the terms under different contexts, which leads to ambiguity. The same applies to the characterization, or types, of worldview. In order to use worldview as a construct in this work, a definition needs to be presented. The same applies for the characterization of worldview.

3.3 ON PROBLEM

Sage (1992, p. 54) defines a problem as "an undesirable situation or unresolved matter that is significant to some individual or group and that the individual or group is desirous of resolving." This account, although simple, is open to ambiguity. This is because there is no description on how to qualify something as undesirable or unresolved besides the inherent need of someone to resolve it. Vennix (1996) remarks that for problems to be considered as such need to be objective and agreed upon. However, in most real life settings where group work is required, most problems encountered by engineers and managers are not agreeable upon. As mentioned in section 2, when problems are not agreed upon but still are perceived as problems by some, they are called problem situations. Problem situation is already a characterization of problems within a group setting. However, for an individual this concept has ramifications; chief among them is that it cannot assume objectivity, on its formulation, and the existence of a known solution that can be readily implemented. Figure 8 shows how the concept of problem has been addressed in this review.

Another characterization of problem is that of soft and hard problems. Flood and Carson (1993) present that the hard school accepts that problems exist and it can be known what the problem is. The soft school, according to Flood and Carson, "accepts plurality in human understanding and interests, rejects the hard view, preferring to assume situations are problematic rather than to accept that problem exist" (Flood &

Carson, 1993, p. 98). The hard and soft differentiation seems consistent with the objectively defined problem and with problem situations respectively.

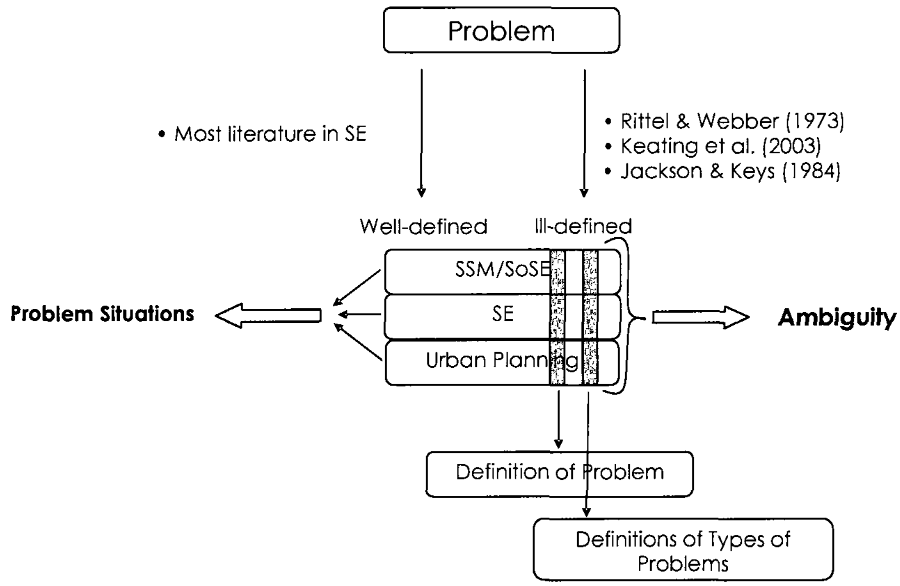

Figure 8. Review on Problem

Jackson and Keys (1984) use on their context characterization the hard and soft differentiation. They posit that some problems are solvable while others are manageable depending on the context. Problems within unitary contexts range from simple (mechanical-unitary) to complex (system-unitary) and can be solved. Within this context, problems are dealt with under the objectively-defined problem premise. Problems within pluralist contexts, many perspectives, range from simple (mechanical-pluralist) to wicked (systemic pluralist). When consensus can be reached, mechanical-pluralist problems can be solved. Wicked problems, or messy as referred to by Ackoff (1974), are not only ill-defined, but also a solution's effect is intractable. Systems Engineering, for instance, focuses on solving complex problems when building complex systems. However, these problems can be well defined and solved given their technical dominance under unitary contexts (Keating, Padilla, and Adams, 2008). On the other hand, soft-systems methodology (SSM) focuses on dealing with wicked problems.

Rittel and Webber (1973), recognized for coining the term wicked problem, identified these type of problems in urban planning. They posit that wicked problems "are a class of social system problems which are ill-formulated, where the conflicting values, and where the ramifications in the whole system are thoroughly confusing." Rittel and Webber also remark:

> *As distinguishable from problems in the natural sciences which are definable and separable and have solutions that are findable, the problems of governmental planning – especially social and policy planning – are ill-defined.*

Rittel and Webber (1973) proposed ten properties to distinguish this type of problem[1]. From the ten characteristics, three points of reference can be drawn:

- The first point refers to formulation of the problem, formulation of the solution, and how these two are intertwined. According to Rittel and Webber, the formulation of the problem *is* the problem not only because we have as many formulations as people formulating the problem but also because the formulation of the problem is in itself a formulation of a solution. The resulting formulation cannot be tested and its possible effects cannot be foreseen with certainty.
- Second, the differentiation between solution as an input and solution as an output. Rittel and Webber mention the "idea for solving" as well as "inventory of all conceivable solutions" which is different than the formulation of a solution. The former refer to the input one needs to have in order to deal with a wicked problem; in Rittel and Webber's words "an exhaustive inventory of all

[1] Please refer to Rittel and Webber (1973) for the list and an explanation of these characteristics

conceivable solutions ahead of time." This inventory is towards the formulation of the problem, not as a final "satisfactory" solution to the problem. That satisfactory solution is the result or output of the formulation process that uses those "conceivable solutions" as inputs. This differentiation is crucial given that known solutions may be implemented without having formulated the problem first which then becomes a trial and error process.

- Last, implementation and traceability of a solution cannot be tested or its effects foreseen with certainty. This leaves the decision maker with little or no capability of learning due to feedback.

Unlike knowledge and worldview, there seems to be a widely accepted definition of problem. This definition suggests that problems are undesirable situations that present a need to take them from point A to a desired point B. However, this definition of problem is open to ambiguous interpretations given that there is no qualifier of what makes a situation as undesirable to an individual. On the characterization of a problem, there seems to be different versions of the same case: objectively defined problems (hard problem, problem found in the natural sciences, unitary context) and problem situations (soft problem, social problem, pluralist context, wicked). Their use is mixed which may lead to ambiguity in their use. In order to use problem as a construct in this work, a definition needs to be presented. The same applies for the characterization of problem.

3.4 ON APPROPRIATENESS

Appropriateness, from the review on understanding, is a reflection on how well knowledge is used. After reviewing that worldview has an effect on problems, it makes sense to suggest that appropriateness is also a reflection on how well worldview is used. For instance, in the body of knowledge it is found that intuition, intuitive perception, intuitive knowledge, and intuitive decision making, is used to deal with problems within particular contexts. Klein (1998) makes this point when firefighters and nurses observe and solve problems by observing cues about patterns or lack thereof. They are able to solve these problems, Klein suggests, because they have knowledge about patterns. Intuitive knowledge is knowledge about patterns. This knowledge is gained through experience. This type of knowledge, within this review, can be seen as tacit, procedural or knowing-how. In addition, worldview is not only about perception but also about describing or making sense about reality. In this line of thought, an intuitive worldview seems to be the more appropriate to make sense of a problem about patterns which was perceived intuitively. This identification of patterns is also highlighted by Hubler (2005). Hubler mentions that *"only if we use a holistic approach, by considering both the bottom-up and the top-down pattern formation process, can we understand the emerging patterns and dynamics."* In this case, holism can also be seen as intuitive perception. Further, holism is required to deal with or describe problems that present emergence. This is because the problem cannot be described through its parts.

On the other hand, it has been documented (Jackson & Keys, 1984; Keating et al. 2008) that problems that are within mechanic-unitary or systemic-unitary contexts can be solved by objectively identifying parts and how they relate to one another. Types of perception and knowledge that seem adequate for this kind of problem is reduction and factual knowledge. A reductionist perception plays a role in the identification of parts, while factual knowledge is used to systematically describe the problem. In addition, reduction is used to describe and deal with the problem as well. This is consistent with Leonard et al.'s (1999) research on field independent individuals. These individuals have the inclination to separate objects from the environment and identification of parts.

This short argument opens a line of discussion about what appropriateness is. In the literature of understanding, appropriateness is suggested as a part of the mapping between knowledge and problem. However, not only this is open to interpretation, but also it does not provide conditions for appropriateness to occur. This argument suggests that appropriateness is about the right kind of knowledge and worldview applied to the problem. Moreover, the application of the "right type" is the condition for the application, of knowledge and worldview, to be considered appropriate. Although appropriateness can be explained in these terms, it needs to be characterized in order to be used within a construct of understanding. This characterization is dependent on the characterization of knowledge, worldview, and problem.

3.5 IMPLEMENTING THE RESEARCH APPROACH

Figure 9 shows how from the two schools of thought found in the literature of understanding common thematic threads can be obtained. Some of these threads become constructs, namely knowledge, worldview, and problem which are used to build a construct of understanding. This construct of understanding will serve as then basis for a model that later will be executed with a simulation. The other threads, such as appropriateness, are characteristics of the concept should help relate underlying constructs. This axiomatic structure should be used jointly with proposed definitions providing an explanation of the concept of understanding, which should result in a theory. This theory should not only be able to explain existing schools of thought and underlying theories, but also should create new insight. M&S will be used throughout, and the computational model will be implemented in agents as noted. Data should be gathered and analyzed for insight.

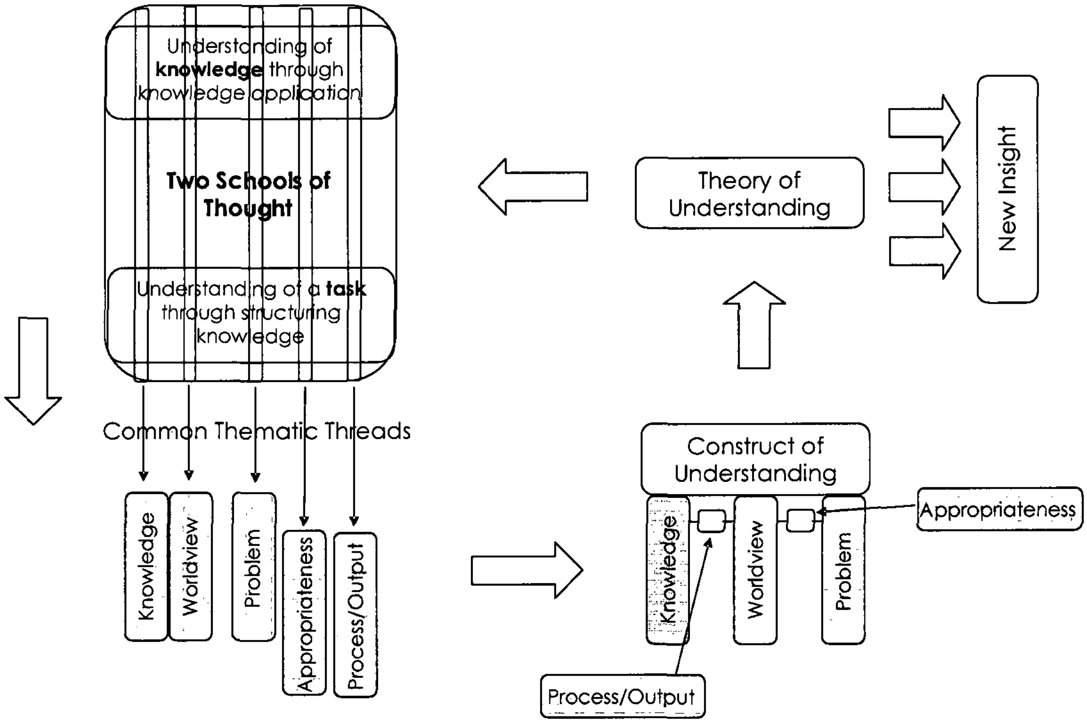

Figure 9. Implementing the Research Approach

3.6 SUMMARY OF DERIVING A CONSTRUCT FOR UNDERSTANDING

This section elaborated on the identified components of understanding, namely, knowledge, worldview, and problem. In addition, the characteristic of appropriateness was also explored. It is shown that, in the body of knowledge, current definitions of knowledge, worldview, and problem are ambiguous or open to interpretation. Further, it is shown that the idea of appropriateness is not explicitly stated, but implicitly used, in the body of knowledge. It is suggested that appropriateness is about the right type of knowledge and worldview to a particular type of problem. It is suggested that definitions for knowledge, worldview, and problem are required to be able to use them to define understanding. In addition, types of knowledge, worldview, and problem need to be characterized as well as appropriateness.

4 TOWARDS A GENERAL THEORY OF UNDERSTANDING (GTU)

4.1 WORKING DEFINITIONS

Definition 1. Knowledge

- *Knowledge is a collection of statements that are true or false.*

Definition 2. Problem

- *A problem is a collection of statements for which the truth value is not known.*

Definition 3. Worldview

- *Worldview is a collection of statements about statements.*

Unlike definitions found in the body of knowledge about these topics, these definitions are precise; they mean one thing and one thing only. This characteristic eliminates ambiguity by stating what each construct is without having to describe the construct or using undefined terms within the definition.

The proposed definitions have one common denominator: statements. A statement is simply an atomically semantic collection of symbols. This means two things: first, symbols by themselves do not carry meaning. Second, a statement does not require another statement to have meaning. Examples of statements are: *tomorrow is going to rain, 2+2=4, Peter likes chips*. Although *2* and *Peter* means number two and the name of someone/something respectively, by themselves they do not carry any meaning. The use of statements also means that a statement does not require ambiguous conditions such as justification or undesirability. The only requirement is that it needs be stated. Finally, this common element is of great importance because it allows first, the three constructs to be related to one another and second, each definition is clearly differentiated from one another.

In the case of the definition of knowledge, it does not depend how the statement was justified, if that statement is true, or if it is just a belief. A person needs to just make a statement that it considers true or false. As it was previously presented, the absoluteness and truthfulness of something may not even be assessed even under scientific conditions. This is particularly true within problem situations where for absolute truth to be established, one needs to know everything about everything, which is not possible. Examples of knowledge are: *2+2=4 (True), the author's name of this work is Jose (True), and Newton proposed the theory of relativity (False).* Notice that knowledge is about the truth value assigned to the statement not about the truthfulness of the statement. In known cases, truthfulness is easy to establish. However, under problem situations it is no longer the case. All that a person can say is that a statement is true or false for that person. As an example, if a person says that Newton proposed the theory of relativity (True), it is indeed true for him/her. In this case, this can be easily refuted given that it is a known fact that Newton did not propose the theory of relativity. If a person says that walls deter illegal entry into the country (True), it may be true for him/her, but it is not trivially refutable or acceptable with known facts.

In the case of the definition of problem, it does not depend on the undesirability of the situation; a person needs to make a statement of what s/he wants to know. Further, this definition is consistent with the definition of problem situations; the moment a person states that s/he does not know something, then it becomes a problem for the person. When statements are compared among people, if they are the same they fall under the category of an objectively defined problem. If they are not, then they fall under the problem situations category. Examples of problems are: *2+2=4 (True or False?), the author's name is Peter (True or False?), and Newton proposed the theory of relativity (True or False?).* These are statements for which truth value has yet to be assigned. It is important to note that, based on definition 1, when truth values are assigned problems become knowledge.

In the case of worldviews, it is not a set of values or a frame of reference. It is both. When making a statement about statements a person presents its values and beliefs reflecting a frame of reference. Notice that worldviews, as being statements about statements, can be statements about knowledge and statements about problems. In other words, individuals have statements about statements for which an individual has truth values assigned and about statements for which it does not have truth values assigned. An example of a worldview is: *because tomorrow is going to rain, Peter would rather stay home*. This statement shows Peter's preference that when it rains he avoids going out. It is a statement (S1) about statements (S2) because S1; *Peter would rather stay home*, is a statement about S2*; tomorrow is going to rain*.

These definitions address the main constructs. In order to address the characterization of these constructs, as found in the literature, the following definitions are proposed:

Definition 4. Alpha Statement

- *An alpha statement is a statement about structure.*

Definition 5. Beta Statement

- *A beta statement is a statement about behavior.*

According to Flood and Carson (1993, p.13), structure "defines the way in which the elements can be related to each other, providing the supporting framework in which processes occur." According to Flood and Carson (1993), behavior is characterized by sequential observations on a system at different times. Further, behavior is derived from the relation between input and output at different times. Figure 10 shows how structure and behavior of a system are observed.

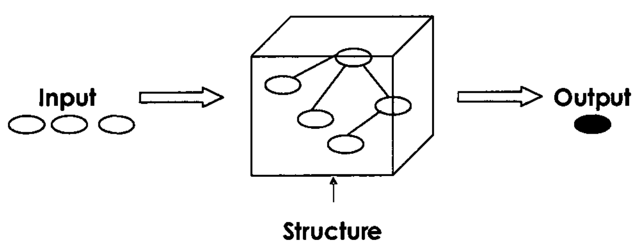

Figure 10. Glass Box with Observable Structure and Behavior

Figure 10 shows a reductionist, linear perspective on structure and behavior. In this case, behavior, the relation between input and output, can be explained through the structure and the structure can be explained through parts and relations among parts. This assumes that a structure is observable and identifiable and that a linear correspondence between structure and behavior can be established. In cases where behavior is more than the observed parts and relations among parts, the behavior is said to be emergent. Now, if instead of a glass box there is a black box, as shown in Figure 11, the structure is not, not even its parts, observable. What is observable are the input and output which represent the behavior on the inside. Behavior, usually sought after, is about patterns (Klein, 1988; Hubler, 2005) or lack thereof (Klein, 1998).

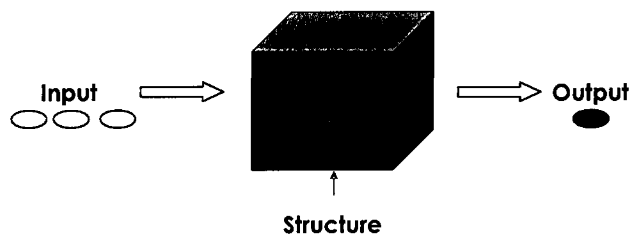

Figure 11. Black Box with Observable Behavior

Using definitions 4 and 5 on definitions 1, 2, and 3: Problem Alpha (P_α) is a collection of statements about structure for which truth value is not known. Conversely, Problem Beta (P_β) is a collection of statements about behavior for which truth value is not known. Knowledge Alpha (K_α) is a collection of statements about structure that are true or false. Conversely, Knowledge Beta (K_β) is a collection of statements about pattern that are true or false. Finally, Worldview Alpha (W_α) is a collection of Alpha statements about statements, and Worldview Beta (W_β) is a collection of Beta statements about statements.

This characterization of knowledge, worldview, and problem is consistent within definitions 1, 2, and 3. More importantly, it reflects the types of knowledge, worldview, and problem presented in section 4 without the ambiguity. K_α and K_β reflect the explicit and tacit characterization of knowledge. K_α and K_β reflect their objective/subjective nature; a structure can be learned, taught, and transferred whereas a behavior is dependent on the conditions where a person is immersed in. W_α reflects the reality-as-outside-of-the-individual premise presented by Keating (2008) and field independence presented by Leonard et al. (1999) by stating something about an identifiable contextless structure. W_β, on the other hand, reflects the individual-within-reality premise of Keating and field dependence of Leonard et al. (1999) by being able to identify patterns, for instance, which are dependent on context. Finally, P_α reflects problems whose behavior is definable by parts and relations among parts. P_β reflects problem whose behavior is not definable by parts and relations among parts. They are defined by the behavior itself.

Given definitions 1 to 5, the definitions of understanding stand thus:

Definition 6. Process of Understanding

- *Understanding is the matching of Knowledge, Worldview and Problem.*

Definition 7. Output of Understanding

- *Understanding is the result of the assignment of a truth value to a problem.*

These definitions present what understanding is, from a process and output perspective. This dual perspective was found in the literature as a characteristic of understanding. Definitions 6 and 7 fulfill this characteristic in a precise manner. Further, definition 7 presents what understanding does; it assigns truth values to problems through the matching of knowledge, worldview, and problem. These definitions are a big departure from the intuitive idea of grasping found in the literature and present understanding as the matching of statements generating statements. Further, the nature of the statements being matched is already defined so there is no ambiguity.

Notice that understanding assigns truth values to problems. By definition, a statement with truth values assigned is considered knowledge. Therefore, understanding is a knowledge creation process. This knowledge creation process is shown in Figure 12.

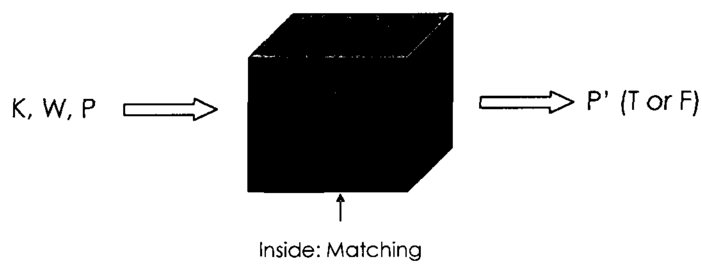

Figure 12. The Black Box of Understanding

Assuming the black box as the mind of an individual, Knowledge (K), Worldview (W), and Problem (W) are inputs to the black box. Inside the box the matching of K, W, and P occurs. The visible output of this process is when a person says it understood. This occurs when P is assigned a truth value and become P'. P' is new knowledge. Further, when P is assigned a truth value of True, the person understood. When the assigned value is False, the person did not understand. This suggests that not understanding is still a form of understanding; the person understands that s/he does not understand.

An explanation, as suggested by Zagzebski (2001), could be considered an output of what was understood. However, an explanation cannot be assessed in the general case. All that can be assessed is a simple yes or no when an individual is asked whether a problem was understood or not. Nevertheless, this explanation is considered an important outcome of the understanding process given that an explanation is a statement about statements. Consequently, understanding is a worldview creation process. This is an important deduction. In the literature there is no description of how worldview is created beyond that it is generated by our surroundings. Understanding is then identified as the process that creates worldview.

It has been defined that understanding is a matching process. This process refers to how understanding occurs. However, a definition is insufficient to elaborate on the process. To shed insight onto the process, a construct of understanding is proposed.

4.2 THE UNDERSTANDING CONSTRUCT (UC)

The understanding construct (UC) is formed by the constructs of knowledge, worldview, and problem. Figure 13 shows the construct.

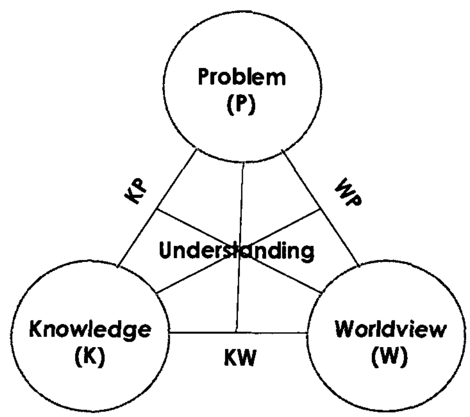

Figure 13. The Understanding Construct

Figure 13 shows that knowledge is matched to problem (KP), knowledge is matched to worldview (KW), and that worldview is matched to problem (WP). This basically says that an individual can apply a solution to a problem, can formulate knowledge, and can formulate a problem respectively. By knowledge being possibly knowledge of solution, KP is a reflection of a problem solving process. A statement about knowledge is a formulation of knowledge. In this case, KW is a reflection of an individual framing knowledge. Lastly, a statement about problem is a formulation of problem. In this case, WP is a reflection of an individual framing problem. However, KP, KW, and WP do not amount to understanding. When W, P, and K are matched to KP, KW, and WP respectively, based on definition 6, understanding occurs. This is shown in

Figure 14a, Figure 14b, and Figure 14c. It is noted that whereas definition 6 and 7 say what understanding is, and definition 7 presents what understanding does, these matching are accounts of *how* understanding occurs.

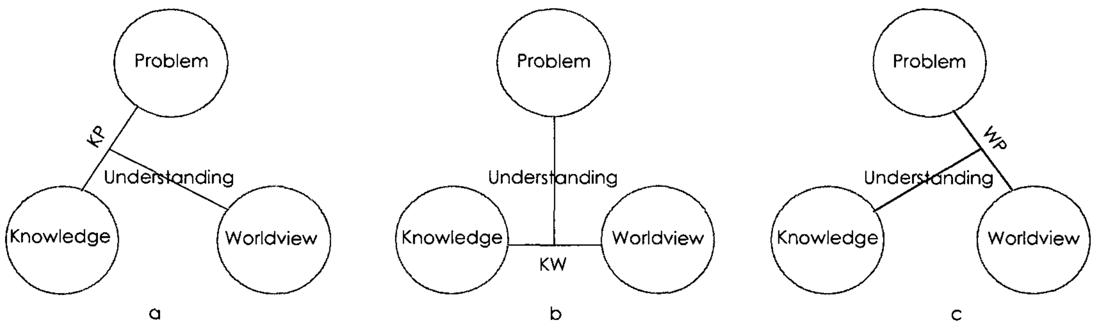

Figure 14. Matching of Knowledge, Worldview, and Problem

4.3 THEORY BUILDING FROM THE CONSTRUCT

In Figure 14a, the matching of KP and W (KP-W) reflects a person understanding a problem through knowledge application. In this case, the person applies its knowledge to a problem assuming that this application can be or explained via structure and/or behavior through a worldview. This explanation amounts to a formulation of a solution. Here, the direct matching of knowledge and problem will allow for understanding of the problem. In other words, K is matched with P first assuming that it will match later with a preconceived W. This preconceived W is already assumed when K and P are matched and confirmed when an explanation is provided.

In Figure 14b, the matching of KW and P (KW-P) reflects a person understanding a problem through knowledge formulation. In this case, the person seeks to formulate, via worldview about structure and/or behavior, her/his knowledge. This formulation will allow him to understand the problem at hand. Here, the person assumes the formulation of the problem is not of importance as long as knowledge is formulated. In other words, P is understood when K and W are matched first and then matched to P.

Finally, in Figure 14c, the matching of WP and K (WP-K) reflects a person understanding a problem through the formulation of the problem. In this case, the person seeks to formulate, via worldview about structure and/or behavior, the problem at hand. This formulation will allow for understanding the problem at hand. Here, the person assumes the formulation of knowledge is not of importance as long as the problem is formulated. In other words, P is understood when P is first matched with W and then matched to K.

These three matching reflect three processes of understanding that are the reflection of three schools of thought.

Two understanding schools of thought (ST) were found in the literature: understanding of knowledge through knowledge application (ST1) and understanding of a task through structuring knowledge (ST2). These schools of thought can be explained by KP-W and KW-P respectively.

ST1 says that an individual can understand a problem or knowledge through the use of knowledge. KP-W reflects these equivalent cases. To understand a problem, knowledge needs to be understood through knowledge being matched to the problem, and a formulation of a solution is presented. This direct matching of knowledge on problem is a form of problem solving whose effect of resulting solution is assumed to be assessable due to a known structured problem. Conversely, to understand knowledge, knowledge needs to be understood through knowledge being matched to a problem and an explanation of knowledge is presented. This direct matching of knowledge on problem is a form of assessment whose explanation should be assessable given that the knowledge being understood is already known and the problem used is already known and structured. It is noted that ST1 assumes a uniquely structured problem; ergo, the worldview is assumed and assumed to be about structure. KP-W eliminates this assumption by considering knowledge and problem about structure and behavior and that either, knowledge or problem, can be formulated through structure or through behavior. In other words, whereas ST1 considers K_α, P_α, and an embedded W_α, KP-W considers K_α, K_β, P_α, P_β, W_α, and W_β.

Examples of understanding when considering K_{α}, P_{α}, and an embedded W_{α}, are found in the Systems Engineering and problem solving literature. In these cases, through an identifiable structure, objectivity can be established. Moreover, the effectiveness of the solution can be assessed given that it was already defined which is then evidence that the problem was understood. Examples of understanding when considering K_{β}, P_{β}, and W_{β} are found in specialized scenarios such as nursing and firefighting where an individual solves problems based on her/his experiential knowledge. Identification of patterns is used instead of identification of structure under these circumstances. Given that these solutions depend on context, they are considered subjective and rely on the assessment of the individual.

ST2 says that an individual can understand a task through structuring knowledge. KW-P reflects this case when knowledge matches to a worldview (knowledge is formulated through a worldview) before matching to a problem. In addition, it explains ST2 under the assumption that knowledge can be uniquely structured. This case is reflected when considering only K_{α} and W_{α} for a problem assumed to be P_{α}. KW-P eliminates this assumption by considering K_{α}, K_{β}, W_{α}, W_{β}, P_{α}, and P_{β}.

KW-P, as mentioned before, is found in the artificial intelligence literature which is interested in how knowledge is formulated, so it can be used intelligently in particular tasks. It is also found during elicitation techniques by answering the question: what do you know that is of use to address a problem?

The understanding construct provides a third school of thought that is not found in the literature. WP-K reflects the case when worldview matches to a problem (problem is formulated through worldview) before matching to knowledge. WP-K is truly the reflection of a problem situation given that even for the same person, the formulation of the problem is subject to change. This change in formulation has an effect on ST1 and St2 given that it changes their understanding based on the assumption of a unique formulation. Further, when considering that the problem can be formulated under W_{α} and W_{β} and then matched to K_{α} or K_{β} the formulation space is even larger.

WP-K is found within the systems thinking and system of systems literature. These bodies of knowledge posit that a unique formulation of socio-technical problems is not possible. Each individual formulation becomes a unique formulation of the world that later must be reconciled. In this case, what was understood is a unique understanding, for a person at a certain point in time.

The understanding construct also provides information about three characteristics mentioned in the literature review: time, appropriateness, degree of understanding.

Time is a condition inherent to the problem or self-imposed by the individual. If time is inherent to the problem and individual may have to meet deadlines. On the other hand, when time is self-imposed by the individual, s/he responds to her/his own deadlines. From these perspectives, time to understand is considered within a window of opportunity (WO), inherent to the problem or self-imposed by the individual, where *the time is allotted to understand the problem. However, providing an answer within a* WO requires having an idea of how to measure understanding. This measurement is provided by appropriateness.

Appropriateness is better expressed by the following propositions:

- Proposition 1. Understanding occurs when:
  - K_i, W_j, *and* P_k *match*
  - *For* $i = j = k$.
- Proposition 2. Not-Understanding occurs when:
  - K_i, W_j, *and* P_k *match*
  - *For* $i =! j$ *or* $i =! k$ *or* $j =! k$.

Appropriateness is a condition achieved when knowledge, worldview, and problem of the same type are matched. When an appropriate match occurs, a person understood. A percentage of appropriately matched statements out of the total considered problems, provide a measurement for understanding at a point in time.

Conversely, when statements do not match it also provides a metric. Not-understanding refers to the fact that a person does not understand. This metric can be seen as a counter that updates every time a person says it does not understand. This counter stops when the person assigns to the last problem statement a truth value of true. Succinctly, the result of this counter, effort to understand, is just the sum of all newly assigned statements with the value of false. Effort to understand plays a crucial role in this work, given that from the next section on is the metric used to assess difficulty on understanding a problem.

In terms of effort, other possible metrics provide a way of assessing what was understood. Three possible metrics for understanding are completeness, truthfulness, and misunderstanding.

Completeness is the number of statements with assigned truth values out of the ones that needed assignment. It answers the question: of all defined statements without truth value, how many of those have an assignation? Truthfulness is the number of statements with correctly assigned truth values out of the ones that needed assignment. It answers the question: of all defined statements without truth value, how many of those truth values were correctly assigned? Finally, misunderstanding is the number of statements with wrongly assigned truth values out of the ones that needed assignment. Three notes are made on these metrics: first, they are not independent. They could be affecting each other. For instance, the completeness metric contains measurements of truthfulness and misunderstanding. Second, these metrics can be measured under fairly simple conditions. And third, these metrics help differentiate concepts from one another. For instance, misunderstanding can now be differentiated from lack of understanding; whereas the former relates to wrongly assigned truth values, the latter relates to not-understanding.

Another important characterization is that of being able to understand. Being able to understand is not the same as not-understanding. This differentiation can be established, at the very least, with the following three conditions: existence, capacity, appropriateness, and relevance.

1. Existence: P must exist for it to be understood.
2. Capacity: K and W must exist for P to be understood.
3. Appropriateness: K, W, and P need be of same type when matched.
4. Relevance: K and W are applicable to P.

Being unable to understand means that conditions (1) and (2) are not satisfied. Conversely, not-understanding does not satisfy condition (3). Condition (4) is a safeguard for condition (3) in that, at the very least, K and W are relevant to P.

4.4 BUILDING A MODEL AND A SIMULATION

The UC and corresponding definitions serve as a formal characterization of the GTU. To establish that this formalism is not only consistent but also able to further generate theory, a computable model and corresponding simulation need to be created. The computable model enhances the formality of the GTU while the simulation generates data that can be analyzed for further knowledge creation.

4.4.1 SELECTION OF THE M&S PARADIGM

The selection of the appropriate M&S paradigm to the problem at hand is paramount. The proposed research approach assumes that this selection was already made. However, this work requires that the selection be made explicitly in order to establish the required academic rigor.

A model is a representation of a system, entity, phenomenon, or process (Davis & Anderson, 2003). According to Zeigler et al. in Diallo, Tolk, and Weisel (2007), a model is a system specification, such as a set of instructions, rules, equations, or constraints for generating input/output behavior. A simulation is the execution of a model to replicate its behavior (Zeigler in Diallo et al. 2007). Davis and Anderson (2003) define simulation as the act of using a simulation engine to execute a dynamic model in order to study its representation of the model's behavior over time. Davis et al. (2007) define it as a method that involves creating a computational representation of the underlying theoretical logic that links constructs together within a world. These representations are then coded into software that is run repeatedly under varying experimental conditions in order to obtain results. This position is consistent with Gilbert and Troitzsch (2005) who present simulation as used as a method of theory development given that we can express theories as procedures in the form of a computer program, which is more precise than the textual form of the procedure, which is helpful in refining the theory.

Dealing with complex phenomena M&S becomes extremely useful given that it allows the researcher to explore possibilities and test the boundaries of theories in development. According to Davis et al. (2007) simulation has become highly significant as a methodology because not only can it provide superior insight into complex theoretical relationships among constructs especially when empirical limitations exist but also because it can provide an analytically precise means of specifying assumptions. Gilbert (2000) says that simulation is particularly useful when dealing with non-linear relations that are pervasive in the social world, relations that get too complicated to be analytically tractable through mathematical or statistical equations.

This insight into complex theoretical constructs is even more important given that, because of the nature of complexity, we may not even be able to establish causal relationships between action and response, between input and output. This implies that any multiple of perspectives can be equally valid in describing the phenomenon due to multiplicity of outcomes. Each one of these perspectives is necessary and all need to be considered. However, empirically this cannot be done. This is where simulation comes into place; as placing reality as a subset of the perspective, perspectives that now become possible alternatives. This characteristic is of crucial importance in this research given the multiple possible perspectives within a problem situation.

Hester and Tolk (2010) posit that the categorization of M&S methods depends on "simulation challenges, which means they are predominantly residing on the implementation level." They propose a model spectrum for engineering that ranges from high abstraction models to high resolution models. The former are less detailed and focused on a big picture. In this spectrum they place the most used M&S paradigms:

System Dynamics (SD), Discrete Event Simulation (DE), and Agent-Based Simulation (ABM). Figure 15 shows the spectrum.

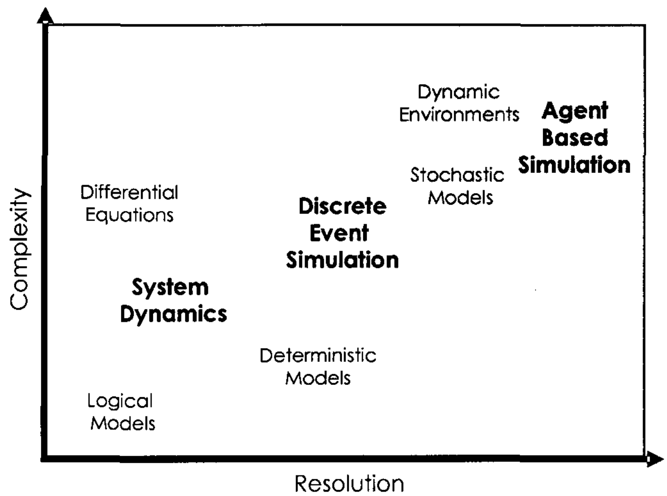

Figure 15. M&S Spectrum for Engineering (Adapted from Hester & Tolk, 2010)

According to Gilbert and Troitzsch (2005), systems dynamics is "described using a system of equations which derive the future state of the target system from its actual state." According to Hester and Tolk (2010), SD models are composed of differential equations describing a system. They are unable to handle stochastic parameters and cannot operate in a parallel environment.

Discrete event simulation is a modeling approach based on the concept of entities, resources, and block charts describing entity flow and resource sharing. Entities are passive objects that represent people, parts, messages, etc.; they travel through the blocks of the flowchart where they stay in queues, are delayed, processed, split, etc. (Borshchev & Filippov, 2004). According to Hester and Tolk (2010), DE can model stochastic systems and can be executed in parallel to reduce computing time.

Agent-based modeling is a "computational method that enables a researcher to create, analyze, and experiment with models composed of agents that interact within an environment" (Gilbert 2008, p. 2). According to Hester and Tolk (2010):

> *Agents can be programmed to work in a cooperative or competitive manner towards other agents. In particular the characteristics of autonomy and flexibility make them of interest to engineers, as they enable to add human-like behaviors to simulation.*

To select the most appropriate modeling paradigm, Hester and Tolk (2010) suggest selecting the lowest resolution possible to model a real world scenario. They remark that this is difficult given the trade-off as simulation complexity increases with increased model resolution.

This work presents modeling challenges, chief among them are:

- There is no equation that describes relation among constructs or a dominant structure to be modeled.
- There is no sequence of events.
- Constructs and premises can be established.

If there are no underlying equations that establish flow rate among objects and underlying structure that shows causality within this work, then systems dynamics is discarded as a candidate for modeling the phenomenon in question. Given that no sequence of events describing entity flow can be established, discrete event simulation is discarded as well. Now, if constructs are seen as agents and premises as underlying rules that explain the behavior of interaction among objects, agent-based modeling becomes the most appropriate paradigm for this work. Hester and Tolk (2010) remark that only ABM can handle dynamic, stochastic, parallel, and continuous problems. This is appropriate in this work given that no preconceived behavior must be built into the simulation.

4.4.2 AGENT-BASED MODELING

According to Gilbert (2008, p. 2): "agent-based modeling is a computational method that enables a researcher to create, analyze, and experiment with models composed of agents that interact within an environment." When talking about ABM, the concept of agents needs addressing. However, the definition of an agent is a contended one in the simulation community (Tolk & Uhrmacher, 2009).

According to Gilbert and Troitzsch (2005, p. 172) "although there is no generally agreed definition of what an 'agent' is, the term is usually used to describe self-contained programs that can control their own actions based on their perceptions of their operating environment." Rusell and Norvig, (2003, p. 32) define an agent as "anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators." Rusell and Norvig present the term *precept* to "refer to the agent's perceptual inputs in a given instant" and the term *percept sequence* as "the complete history of everything the agent has perceived." Figure 16 reflects the agent concept as presented by Rusell and Norvig.

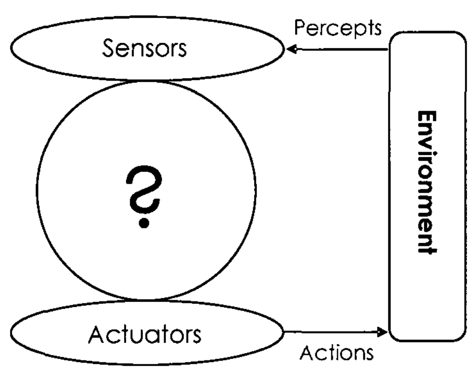

Figure 16. A Basic Agent Structure (Adapted from Russel & Norvig, 2003, p. 33)

Tolk and Uhrmacher (2009) propose that an agent should *perceive* its environment, and *act* in its environment. Further, an agent should *communicate* with other agents to establish a *social ability*. Moreover, an agent should be *autonomous*, outside of central control, and *flexible*, being able to *react* to, *pursue goals*, or *adapt* to changes in its environment.

Moya and Tolk, in Tolk and Uhrmacher (2009), state that there are three external and four internal architectural domains. External domains "comprise those functions needed within an agent to interact with his environment" (p.97). These external domains are: perception domain, which observes the environment through sensors and sends information to internal sense making domain; action domain, which comprises effectors to act on its environment; communication domain, which exchanges information with other agents or humans. Internal domains "categorize the functions needed for the agent to act and adapt as an autonomous object" (p. 98). These internal domains are: sense making domains, which receive input and map this information to the internal representation. The decision making domain supports methods that are reactive and deliberative. These methods lead to action. Adaptation domain updates current goals, tasks, and desires. Finally, the memory domain stores all information needed for an agent to perform its tasks. Figure 17 presents this architectural frame.

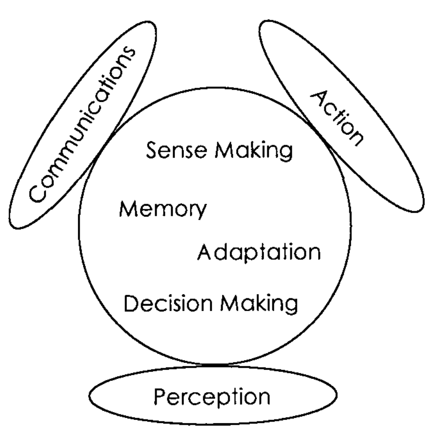

Figure 17. Agent Architectural Frame (Adapted from Tolk & Uhrmacher, 2009)

As a modeling paradigm, agent-based modeling has become very popular recently in the social sciences for its appeal for building models where individual entities and their interactions are directly represented (Gilbert 2008). Axelrod (1997, p. 3-4) calls agent-based modeling the third way of doing science:

> *Like deduction, it starts with a set of explicit assumptions. But unlike deduction, it does not prove theorems. Instead, an agent based model generates simulated data that can be analyzed inductively. Unlike typical induction, however, the simulated data come from a rigorously specified set of rules rather than direct measurement of the real world.*

Abrahamson and Wilensky (2005) present three main contributions of ABM to the advancement of theory:

- Explicitizing: The ABM environment demands an exacting level of clarity and specificity.
- Emergence: ABM enables the researcher to mobilize an otherwise static list of conjectured behaviors and witness any group-level patterns.
- Intra/interdisciplinary collaboration: ABM serves as *lingua franca* enabling researchers who otherwise use different framework terminology and methodology to understand and critique each others work.

Explicitizing is crucial in any research in a manner that demands to declare assumptions and presuppositions about the model and especially about the system or theory being modeled. In addition, it provides a high level of formalization and precision that would not be achieved if the theory is expressed in natural language (Gilbert, 2008). Emergence occurs when interaction among objects at one level gives rise to different types of objects at another level. Emergence is one of the most important ideas from complexity theory (Gilbert & Troitzsch, 2005). This interaction among objects is translated to interaction among agents making emergence a characteristic widely associated with this modeling paradigm. Finally, intra/interdisciplinary collaboration allows for researchers across disciplines, political science, biology, and engineering, to collaborate by constructing models together that can use each one of their theoretical strengths from their own fields.

Jennings (1999) suggests two drawbacks of ABM:

- The patterns and the outcomes of the interaction are inherently unpredictable.
- Predicting the behavior of the overall system based on its constituent components is extremely difficult (sometimes impossible) because of the strong possibility of emergent behavior.

Referring to bullet one, Axtell (2000) remarks that robustness of results can be assessed with a sufficient number of runs and systematically varying initial conditions. Referring to bullet two, emergence is also advantageous. This is because we can see the overall behavior of the system as it is more than the sum of its parts.

4.4.3 MODEL ANALYSIS

Simulation is used in this work because it is suited for developing theories. Davis et al., 2007 remark that simulation enhances theoretical precision and enables theory elaboration and exploration. Ören (2009, p. 15) takes this idea further and states that "simulation can be perceived as a computational activity, systemic activity, model-based activity, knowledge generation activity, and knowledge processing activity."

As a computational activity, Ören remarks that "the role of the computer in simulation spans from generation of model behavior to simulation-based problem solving environments." (p. 15) He suggests that this perspective is likely to hinder high-level possibilities of simulation-based computer-aided problem solving environments such as experimental frame specification. As a systemic activity, Ören presents M&S as a way of representing a system in terms of inputs, states, and outputs. He remarks that this perspective presents the difficulty of "finding the state variables which may satisfy the input-output pairs." (p. 15) As a model-based activity, Ören presents M&S as a form to study different activities such as model composability, model-based management, parameter-based management, and symbolic modeling. As a knowledge generation activity, Ören states that "from an epistemological point of view, simulation is a knowledge generation activity." (p. 15) He remarks that the generated knowledge is model-based experiential knowledge. Finally, in seeing M&S as a knowledge processing activity, Ören remarks that it allows for integrating simulation with other knowledge processing techniques. The perspective of M&S as a knowledge generation activity is the one used in this work.

Given that all the elements of a conceptual model are in place (components of understanding, process that relates components, and conditions of understanding) a simulation seems to be the next logical step. In order to do so, the understanding construct is converted into a computable model representation. This model is implemented using agents and simulated in order to collect data. Data provide insight into the process of understanding through generalizations.

The Systems Engineering Process (SEP) is used to analyze, design, and implement the model. Figure 18 shows the SEP and all its steps. (DAU, 2001, p. 31-33) presents this process starting with the process input which reflects objectives, requirements and major constraints. Requirement Analysis is used to develop functional and performance requirements: what the system must do and how well. Using Functional Analysis is the decomposition of requirements into lower level functions resulting in a functional description of the product. Synthesis builds up on the analysis in terms of the implementation. These three stages are assisted by the requirement loop allowing for the traceability of the function to the initial requirement, the design loop allowing for the traceability of the elements to be implemented to the function, and the verification loop allowing for the traceability of the implementation to the original requirement.

Systems Analysis and Control is an overseeing activity of all the steps of the process. The process output reflects any data or processes needed to develop the product.

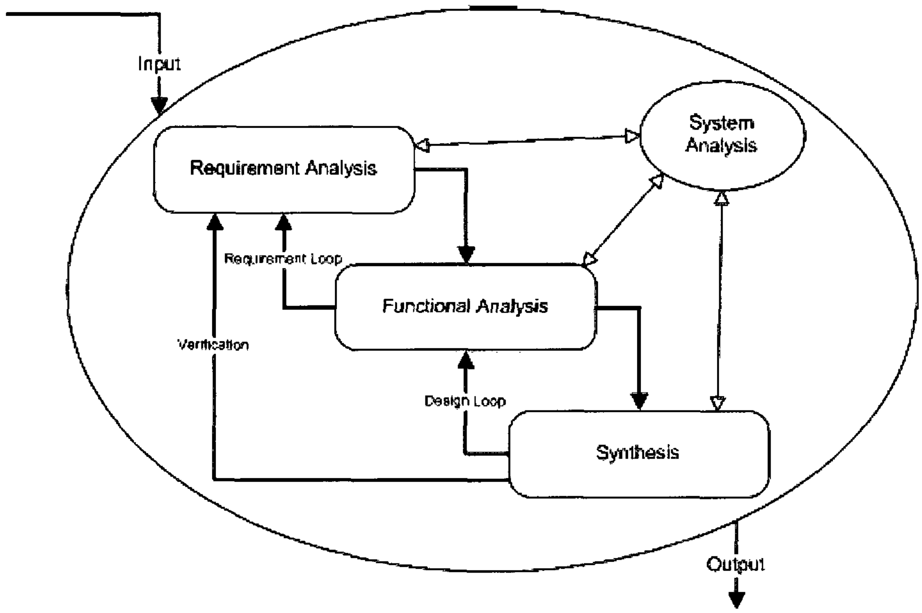

Figure 18. The Systems Engineering Process (Adapted from DAU, 2001)

The reporting of the SEP traditionally is a collection of documents that contain a list of requirements or measures of performance, for instance. However, modeling alternatives such as block diagrams or UML (Unified Modeling Language) are widely used in systems engineering (Ogren, 1999). UML, for instance, provides the advantage of covering all modeling phases while being reusable and graphical in nature (Bahill & Daniels, 2002). The International Council on Systems Engineering (INCOSE) highlights the use of Systems Modeling Language (SySML) to model complex systems to provide "standards representations with well defined semantics that can support model and data interchange." (INCOSE, 2007, p. 7.7)

UML is used in this dissertation to guide the modeling effort. UML highlights *what* needs to be done and *how* it needs to be done. Some of the most used diagrams are use case, class, state machine, activity, and sequence. Use case diagrams in UML capture elements and main processes in a model while defining requirements. Class diagrams capture the static structure of a system by showing how different elements relate to one another. State machine diagrams capture the overall behavior of a system at any point in time and activity diagrams capture activities within states. Finally, sequence diagrams show interaction in elements in a sequence. These diagrams are presented in two batches: one batch presents a paradigm-independent analysis and design of the problem; the other presents an implementation-oriented design of the solution of the problem. The diagrams presented are simple diagrams, given that this is a simple model. However, the model is complete enough to convey a system that reflects the process of understanding.

What

The high level requirement of this model is to help address the research goal: *to provide an experimental setting that not only reflects the process of understanding, but allows for analysis of results to gain insight into what was understood*. In order to do so, constructs and relations among those constructs need to be formulated. From the discussion from the previous section, three constructs need to be considered: knowledge, worldview, and problem. Figure 19 shows these constructs in a use case diagram. At the heart of this model lie the rules that allow for these constructs to relate to one another which are the matching of knowledge (K), worldview (W), and problem (P) and the fulfillment of the condition of appropriateness. These rules are based on definition 6 and propositions 1 and 2 that when put together form a system of premises.

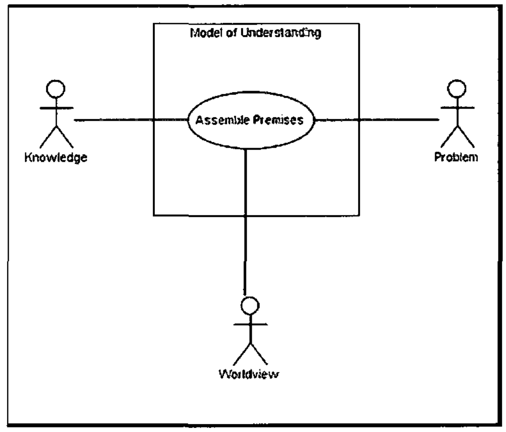

Figure 19. Constructs of the Model of Understanding

In order to further discuss these constructs and the relations in which they are involved, characterizations of those constructs are needed. Figure 20 provides a class diagram with the characterization of K, W and P derived from definitions 4 and 5.

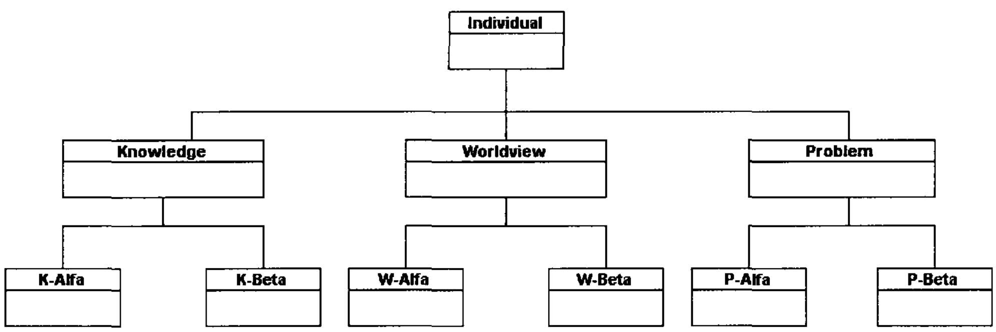

Figure 20. Class Diagram of the Model of Understanding

Figure 20 shows the breakdown of an individual in constructs needed for understanding. The individual has a knowledge base, with a collection of **K**α and **K**β; worldview, with a collection of **W**α and **W**β, and what it considers its problem, with a collection of **P**α and **P**β.

How

Behavioral diagrams show *how* the system works. Figure 21 shows the state machine diagram for an individual. This diagram shows the states an individual goes through when understanding a problem, namely, selection of K, W, and P; matching of K, W, and P; and assessment of effort. Given that the model focuses on establishing a baseline, there is no suggestion regarding the selection process in order to avoid introducing a particular strategy. Instead, that selection is to be implemented as random. The matching occurs under the three schools of thoughts, KW- P, KP- W, and WP- K. Finally, the assessment of effort is reflected with the update to a counter every time the individual says it does not understand.

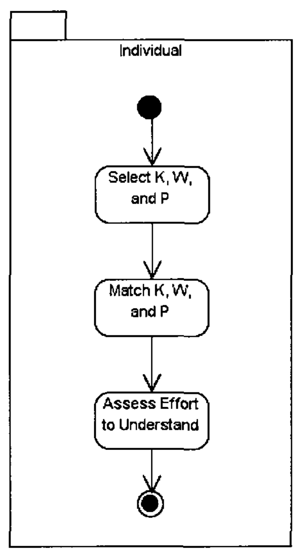

Figure 21. State Diagram for the Model of Understanding

A more elaborate form of adding more information is an activity diagram. Figure 22 is an activity diagram that represents how an individual selects from the knowledge base, from its worldviews and from the already identified problem. To make the assessment of effort, a counter is set up to account for mismatching of K, W, and P counting until the last P is understood. When understanding occurs the problem statement that was understood is no longer considered. Just as the state diagram, one activity diagram is considered for the three schools of thought of understanding given that it presents the same process of selection, matching, and assessment what differs is the way the matching is done.

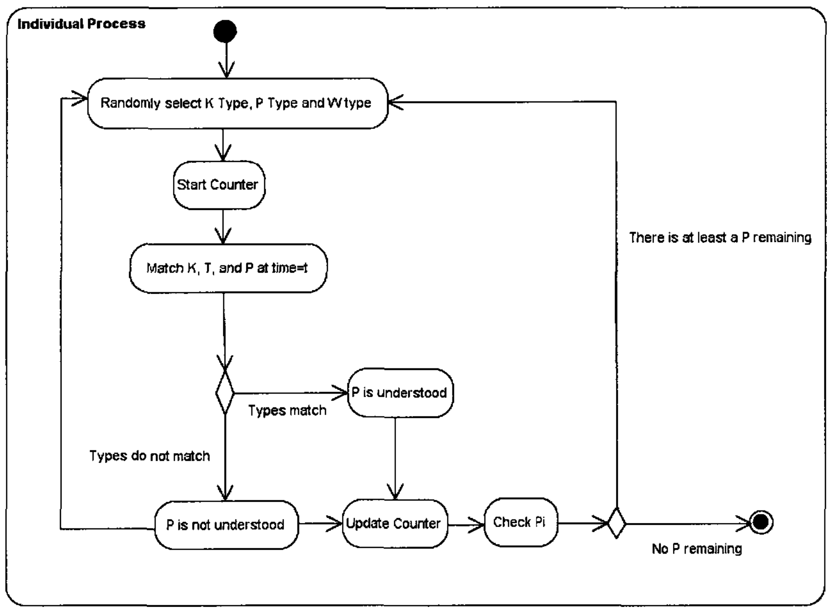

Figure 22. Activity Diagram for the Model of Understanding

Implementing UML with NetLogo

Figure 23 shows an agent-based class diagram. The class diagram is the only of the previous diagrams that convey more information under this implementation. Use case, for instance, under an agent notation remains the same.

NetLogo is a multi-agent modeling language developed by Uri Wilensky at the Center for Connected Learning and Computer-Based Modeling of the Northwestern University of Evanston (US). It is conceived with the purpose of implementing simple rules into to agents and observe emergent phenomena. According to Albiero, Fitzek, and Katz (2007, p. 579)

NetLogo is particularly convenient for the analysis of any complex system developing over time, as the programmer can give instructions to thousands of independent agents all operating concurrently.

For this research, agents can be either turtles (name of moving agents within the NetLogo environment) or patches (not moving agents). Patches are the minimal unit of the grid division over which turtles can move.

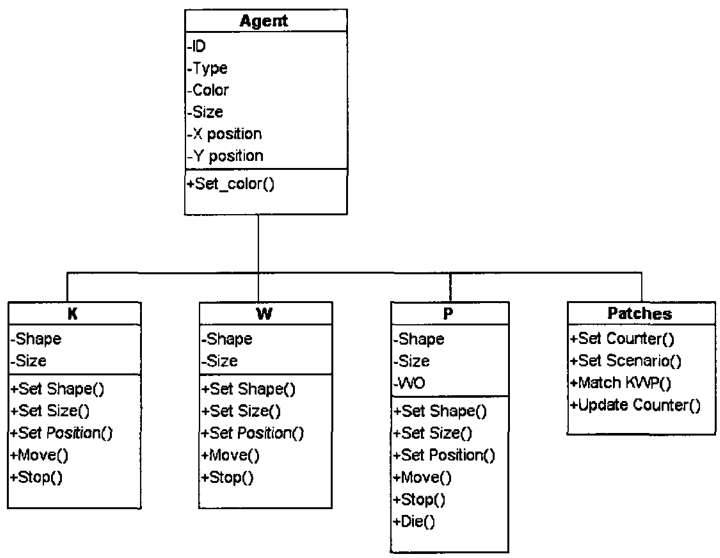

Figure 23. Agent-based Class Diagram for the Model of Understanding

Figure 23 shows the agent entity and some of its attributes and methods. These attributes and methods are passed onto turtles representing knowledge, worldview, and problem. In the implementation, a patch is also an agent that shares some of the attributes and method with turtles. To avoid giving turtles strategies, main processes, such as counting and matching of turtles are given to patches. When turtles arrive to a patch some of these processes are triggered. In the case where the three types arrive to a patch the matching of K, W and P takes place. In other words, the rules of interaction among agents were given to the patch where they stand. This is an implementation decision. The agents are reactive agents whose action is totally random. The matching, which is at the heart of the rules of interaction depends on the school of thought under consideration. Those rules of interaction are shown in Figure 24 with a sequence diagram.

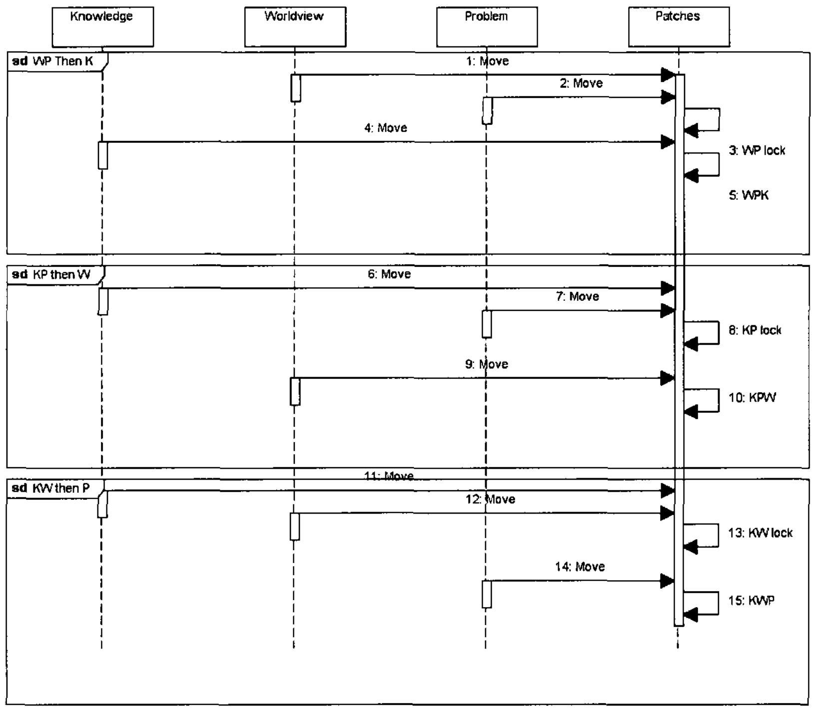

Figure 24. Sequence Diagram for the Model of Understanding

A sequence diagram has shortcomings when used to show interaction among agents given that agents run in parallel instead of a sequence. Additionally, there is no difference in which agent arrives to the patch first. For instance, during KP-W a knowledge agent can arrive first and worldview agent second or vice versa to a patch. However, this diagram reflects the three schools of thought or types of understanding established by the theory as it shows their implemented sequence.

For instance, the KP-W matching is implemented through the simultaneous overlapping of K, W, and P agents. The match, however, starts with the first two agents to arrive. In KP-W, if K and P arrive first, then they are locked waiting for a W turtle to arrive. For WP-K, if W and P turtles arrive first then they are locked waiting for a K turtle to arrive. Finally in KW- P, if K and W turtles arrive first at a patch then they are locked waiting for a P turtle to arrive. The locking time is the window of opportunity (WO) mentioned in section 5. WO affects only KP-W and WP-K which are the ones where the initial match, KP and WP respectively, contains a problem. If within this window of opportunity for KP and WP, W and K turtles, respectively, do not arrive then the agents separate. For the KW match, the wait is for a P turtle so the match is not affected by the window of opportunity. They do separate however, when a P turtle arrives and the matching occurs. This is to avoid the effect of memory in the matching and allowing K and W agents to move freely.

It is important to mention that this is *an* implementation and may not be *the* implementation. What this implementation provides, however, is the advantage that it is looking for a baseline, meaning looking for what understanding is, and not to reflect strategies on how understanding can be performed better. For that purpose, strategies such as memory, or preconceived strategies by the researcher are left out.

Finally, as the loops in Figure 24 suggest, the SEP is not linear. Iterative steps take place in between the SEP. In addition, the first step in the verification of the model has taken place by tracing the constructs and rules to be implemented in the model back to the theory from where they were generated via intermediate definitions and propositions. Finally, this computer model allows for the experimental setting presented by the high level requirements. The results are obtained after the simulation is executed.

4.4.4 MODEL IMPLEMENTATION

Up to this point, the overall modeling process has progressed from what the system needs to do and how to what and how it needs to be formulated using an UML agent-oriented notation. From this point on, these subsections are more focused on the computer *simulation* of the model. This is still considered part of the design process, but it was separated for presentation purposes.

Throughout the modeling process, what it has been shown are turtles with attributes and methods, interacting in a matching process under three scenarios.

The interaction within the simulation, is derived from definitions 4 and 5 and propositions 1 and 2. In other words, when corresponding types of statements, alpha or beta, match understanding occurs. When mismatch between types occur then counter adds 1 towards effort to understand.

Propositional Logic of the Agent Simulation

- *Let's define:*
  - $A_1 = K_\alpha$ *in patch*
  - $A_2 = K_\beta$ *in patch*
  - $B_1 = W_\alpha$ *in patch*
  - $B_2 = W_\beta$ *in patch*
  - $C_1 = P_\alpha$ *in patch*
  - $C_2 = P_\beta$ *in patch*
- *In order to have a match, K, W and P agents must be on the same patch. Only three agents are accepted per patch at the time.*
- *Understanding occurs and P_i is eliminated when:*
  - $Ai \wedge Bi \wedge Ci$
  - *For i = 1 or 2*
- *Not-Understanding occurs when:*
  - $Ai \wedge Bi \wedge Ci$
  - *For i = 1 and 2*
- *Unable to Understand or not-Understand when:*
  - $\neg (A_i \wedge B_i \wedge C_i) \vee (A_i \wedge \neg(B_i \wedge C_i)) \vee (B_i \wedge \neg(A_i \wedge C_i) \vee (C_i \wedge \neg(A_i \wedge B_i)) \vee (\neg A_i \wedge (B_i \wedge C_i) \vee (\neg B_i \wedge (A_i \wedge C_i) \vee (\neg C_i \wedge (A_i \wedge B_i))$
  - *For i = 1 and 2*

Understanding and not-understanding are both considered within the simulation. The former allows P turtles to be eliminated while the latter allows accounting for effort to understand.

Structure and Behavior of Agents

The agents modeled in this work are simple agents with no additional learning or decision making capability. This is because the objective is to establish a baseline with no strategy or the possibility of creating a pattern of behavior. Rusell and Norvig (2003, p. 46) defined these agents as simple reflex agents. These are agents that "select actions on the basis of the current precept, ignoring the rest of the precept history." They also state that "simple reflex agents have the admirable property of being simple, but they turn out to be of very limited intelligence" (p. 47). The structure of this type of agent is presented in Figure 25.

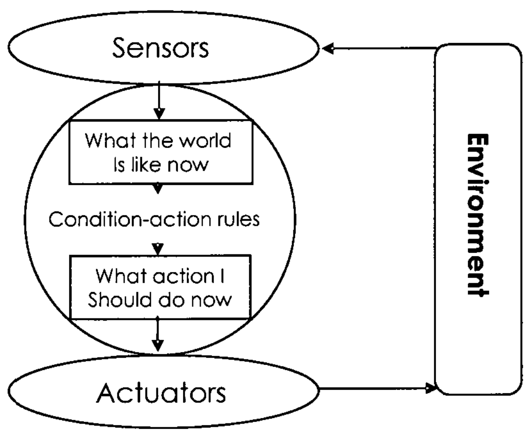

Figure 25. Diagram of a simple agent (Adapted from Russel & Norvig, 2003, p. 47)

In other words, the agent bases any decision taken on its actual state without considering any past state. Russel and Norvig (2003) state that these agents only work if the environment is fully observable[2]. However, this is not the case here given that the environment is not fully observable by an agent. To overcome this hurdle, According to Russel and Norvig, the next action can be determined by randomizing the actions an agent can take. This random behavior, they posit, can be rational in some multiagent environments whereas for single-agent environments, a more sophisticated agent is better.

Given that the model is conceived to be run as a multi-agent simulation looking for a baseline, a simple reflex agent with fully random actions is considered the most appropriate. In the case that a rule set of behavior describing understanding existed already or that one wants to evaluate how to better understand (having already defined what understanding is) the use of a goal-based or utility-based agent need to be considered. This, however, is outside of the scope of this research.

Rusell and Norvig (2003, p. 43) state that the hardest case of the environment and agent can be placed in is where it is partially observable, stochastic, sequential, dynamic, continuous and multi-agent[3]. This agent-based model has been conceived is *partially observable*, *stochastic* (next step of the environment is not completely determined by the current state), *episodic* (next episode does not depend on previous actions), *dynamic* (environment changes while agent is deliberating), *discrete* (finite number of distinct states and discrete set of percepts and actions), and *multi-agent* (considering K, W, and P as distinct types of agents).

In summary, to establish a baseline for understanding:

- No predisposed idea is built in the model. Everything is based on premises derived from existing theory.
- All forms of movement and interactions are random.
- In addition:

[2] A task environment is effectively fully observable if the sensors detect all aspects that are *relevant* to the choice of action; relevance, in turn depends on the performance measure (Rusell & Norvig, 2003, p. 41). They state that little unobservability can cause serious trouble when using this kind of agent given that they would run into infinite loops. Reason why, randomizing their next step is needed.

[3] For a full description on these task environments, please refer to Russel and Norvig, (2003, p. 40-43)

- No memory
- No sequencing

- No mathematical function that relates constructs.
- The output is truly emergent based on simple rules of interaction among simple agents.

A Computer Implementation

The interface presented in Figure 26 was created in Netlogo 4.1 containing a way of establishing initial conditions for the simulation, in terms of knowledge, worldviews, problem, window of opportunity, and school of thought. In terms of output and for verification purposes, what was understood, what was not understood and problems remaining are presented. Window of opportunity (WO), as it was initially highlighted, was created to consider the effect of time within the construct of understanding. Agent-Type is a switch used for verification purposes. It shows the type of agent on the screen.

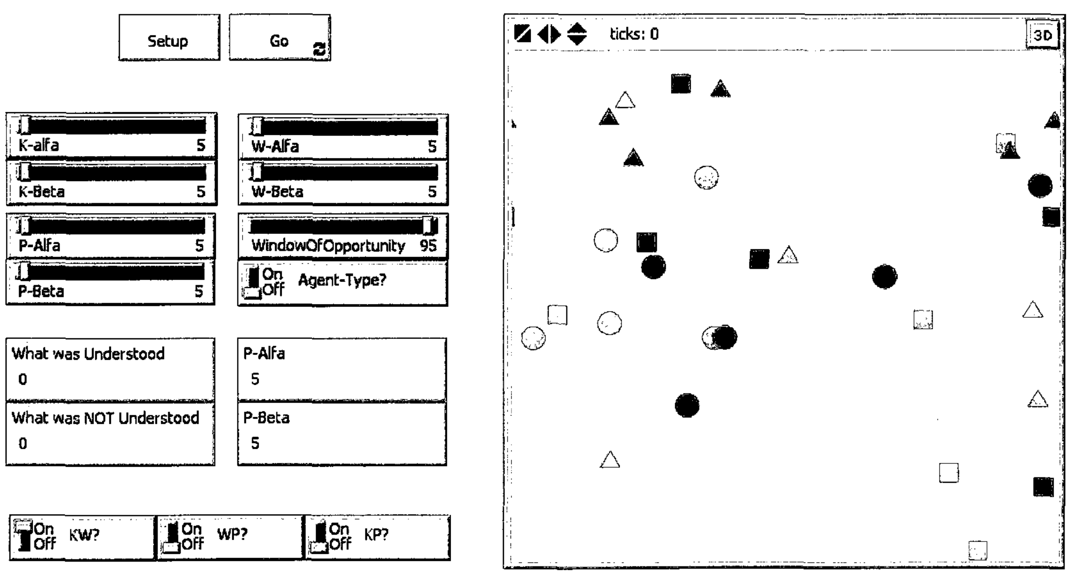

Figure 26. Interface of the ABM for the Model of Understanding

Different initial conditions translate into the different ways a problem can be understood depending on the knowledge base, worldviews of an individual, the way the problem was perceived, and the time constraints the problem has in order to be understood. Given that there are many possible initial conditions, depending on the different combinations of K, W, P and WO, a design of experiments (DOE) is needed to narrow these possible combinations to a manageable number where results can be analyzed and conclusions can be drawn.

4.4.5 MODEL SIMULATION

According to Kuhn and Reilly (2002), "DOE seeks to maximize the amount of information gained in an experiment by optimizing the combinations of independent variables." This is achieved by "manipulating levels or amounts of selected independent variables (causes) to examine their influence on dependent variables (effects)" (Fisher, 1960).

The independent variables, or factors, considered in the model are:

- *Knowledge*
  - K_α
  - K_β
- *Worldview*
  - W_α
  - W_β
- *Problem*
  - P_α
  - P_β
- *Window of Opportunity (WO)* = time where the problem is amenable to be understood.

The dependent variables considered in the model are:

- *Time:* how long it took for the whole problem to be understood.
- *Effort to Understand*: how many mismatches it took for the problem to be understood.

Table 1 shows the factors and levels under which the factors are going to be studied. The DOE presents each variable to be experimented at two levels. Given that there are seven variables at two levels, 128 experiments are needed (2^7). Numbers 5 and 95 reflect the number of agents for each type of K, W, and P. In this case, the numbers reflect a low or high number of statements.

	LOW	HIGH
Kα	5	95
Kβ	5	95
Wα	5	95
Wβ	5	95
Pα	5	95
Pβ	5	95
WO	5	95

Table 1. Factors and Levels of DOE

The Behavior Space feature of NetLogo was used to conduct the experiments set up by the DOE. Initial conditions for the DOE are shown in Appendix A.

To obtain the data corresponding to dependent variables considered in the model, the following setup was followed:

- Ten (10) experiments per 128 initial conditions per 3 scenarios (3840 experiments) were conducted with the purpose of identifying the number of runs needed to establish a statistical significance within a 95% confidence interval and within a margin of error of 10%, which means that 95% of the time, the results will be within 10% of the mean. 95% confidence interval is the one adopted traditionally with a 5% margin of error. However, 10% margin of error was selected to provide a basis for testing the boundary limits of the theory without running an extensive number of experiments. The sample number, that gives confidence interval and margin of error, can be found in most statistics books. For the specific case as it applies to M&S see Kelton, Sadowski, and Sturrock (2004).
- For a 95% confidence interval and within a margin of error of 10% it was determined that 250 runs were needed.
- 128 initial conditions x 250 runs x 3 scenarios = 96000 experiments.

4.4.6 MODELING ASSUMPTIONS

As previously mentioned, one of the main advantages of using M&S is that assumptions can be made explicit. Even if they are implicit, third parties can question assumptions obviated or neglected by the researcher. Assumptions are needed for many reasons, among them the necessity to simplify reality and facilitate the modeling process making them crucial in the abstraction process. As with any other model, this model has its assumptions. Assumptions are driven by the main premise of the modeling effort which is to establish a baseline for understanding with the proposed model. This means that strategies on how to achieve better understanding, process of learning, and processes of problem solving and decision making are purposefully left out and anything that conveys what understanding is needs to be considered.

Modeling Assumption 1. Closed System

A closed system seeks to establish the boundaries of the model and assure what is being simulated is in fact understanding. The closed system assumption covers three assumptions: first, the problem is in a person's head and is not being affected by the evolution of the problem in reality. This also assumes that the way the problem arrives in a person's head is inconsequential as long as it is there. Having an open system eliminates traceability, but more importantly it may be prone to feedback that reflects the process of learning. In addition, new problems in the system are a function of perception and not of understanding which confounds perception with understanding. This would require a learning model that allows for adjustment to the new situation as it evolves in reality, which then is no longer an understanding model. In addition, the model would require action to affect that reality which then becomes part of a problem solving or decision making process. Further, one would need to consider the feedback of action which then becomes a learning process. Finally, if how the problem was perceived as a problem was to be considered, a formulation of the process of perception, or a perception model, would be required which is in itself a separate process. Second, the person is limited to the knowledge s/he has. This implies that no learning takes place to *enhance* understanding. Third, worldview and knowledge do not mutate. According to the literature, worldview and knowledge are subject to change or convert to the opposite kind. Worldview change after action has been taken and feedback of a negative outcome prompts the change. Given that no action is considered, worldview remains the same. Knowledge converts from one kind to the other. However, given that the conditions under which the change happens are not specified as part of understanding within the literature, this conversion is not considered.

Modeling Assumption 2. Convergence of Simulation

On the DOE presented, low level of the factors is not zero. When one of the factors is zero, the individual is not able to understand. This assures understanding given unlimited time to run. This also considers not understanding as a form of understanding, but it takes it as the effort the individual makes to understand the problem while allowing for the consideration of time. In other words, the model considers how much effort and how much time it took to understand the problem.

Modeling Assumption 3. Independence of Problems

One argument that could be made is that problem agents are related to one another. However, this argument brings another assumption: one that requires a unique formulation of that structure making it an instantiation of a problem and a limitation to establishing the general case. Moreover, a unique formulation denies the possibility of alternate formulations which is at the heart of problem situations. Further, the existence of many structures is as good as no structure. Finally, the assumption of a structure implies that there is some understanding of the problem which says that the problem has a structure. All these reasons justify the consideration of a problem to be independent of one another; to allow for the establishment of a baseline for understanding without introducing any bias.

Modeling Assumption 4. Independence of Knowledge

Knowledge may also be considered as the connection of statements we know. However, it is not knowable what structure these statements have unless one refers to a specific formulation of a specific knowledge base which then becomes an instantiation of a knowledge system. Further, knowledge dependence assumes that understanding has already occurred and that allows an individual to relate one statement to another. This is valid when formulating knowledge based on a machine, but it most definitely does not reflect how knowledge is structured in a person's head. In other words, no knowledge structure should be assumed.

Modeling Assumption 5. Independence of Worldview

As with problems and knowledge, worldview could also be related. However, for the same reason provided above, they should not. One characteristic that is unique of worldviews when it comes to independence is that if this is not enforced, one could quickly fall into strategies that efficiently and effectively seek structure of behavior distancing the effort of establishing a baseline.

Modeling Assumption 6. Homogeneity of Knowledge, Worldview, and Problem

This assumption establishes that one statement (K, W, or P) is no more important than another. In reality, this is not necessarily true given that some elements of the problem, for instance, are likely to be more important than others. The same applies to knowledge and worldview. However, if this assumption is not made, just as assumptions 3, 4, and 5, it is said that something is understood of K, W, and P. The main premise of the model is that no previous understanding of anything exists in order to establish a baseline with no bias.

Modeling Assumption 7. Matching of Types and Reusability of K and W

One of the prevalent premises from the AI account is that of mapping between knowledge and problem. This idea of mapping, although, correct is applicable only on specific cases where it is known that some elements can in fact be mapped. This is not the case in problem situations. One statement can be appropriate to many statements (reuse) which truth value is unknown given that the question of appropriateness cannot be answered. This would imply knowing in advance the unique solution to that problem reflecting previous understanding. Therefore, appropriateness can only be established by matching corresponding types of knowledge, worldview, and problem (matching of types) and abiding by the propose conditions of understanding. For instance, if a true statement is matched with a problem and the statement is not relevant to the problem, then even if the types match, the individual is not able to understand.

4.5 DATA ANALYSIS

The purpose of the M&S approach was to facilitate structure and generate data from which generalizations can be made. These characteristics are under the establishment of a baseline for understanding. A baseline is equivalent to a control condition for experimentation. In this particular case, the baseline reflects what was understood as independent from possible concurrent processes such as learning or from particular techniques such as those used to better understand.

As a way to guide the analysis, emergence of patterns is sought through results, then a qualitative assessment is conducted to establish expectations, and finally a quantitative analysis is performed on observations from the qualitative assessment.

Observations of patterns are based on the graphs generated by the calculations of means for 250 experiments for the 128 initial conditions. Figure 27 shows the overlapping of effort of the three types of understanding. It is known that the matching of K, W and P is what generates *understanding* or *not-understanding* and that appropriateness is what differentiates one from the other. As presented by Nickerson (1988), the best way to study understanding is through not-understanding, which is seen as the *effort* it takes for an individual to understand. Figure 28 shows the overlapping of *time* (an individual takes to understand) of the three types of understanding per initial condition. Window of Opportunity is introduced to compare what was understood given a time constraint.

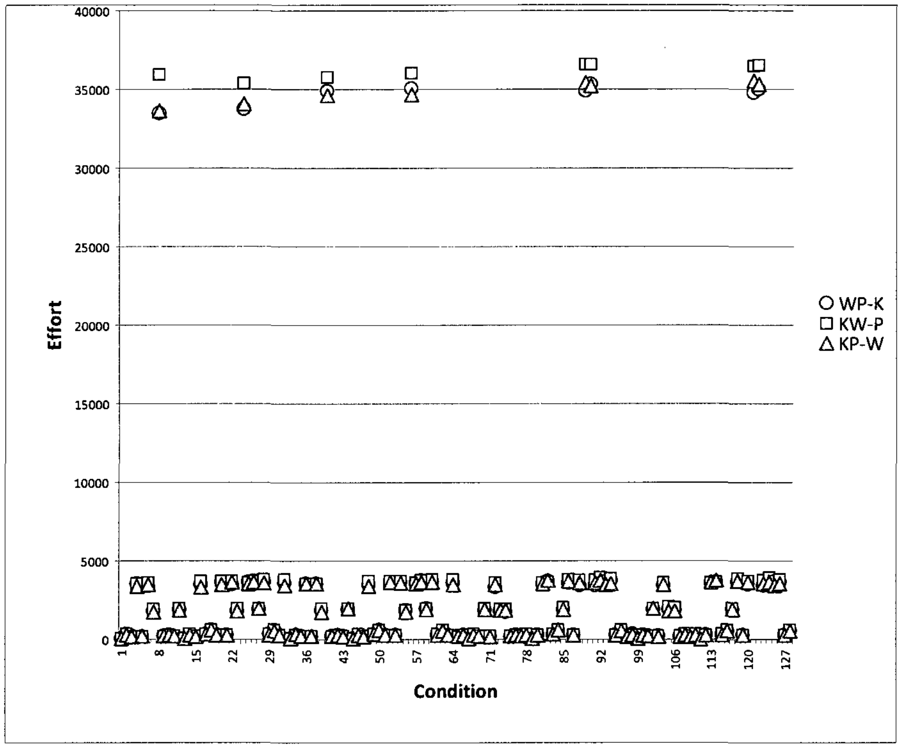

Figure 27. Means Comparison for WP-K, KW-P and KP-W (Effort)

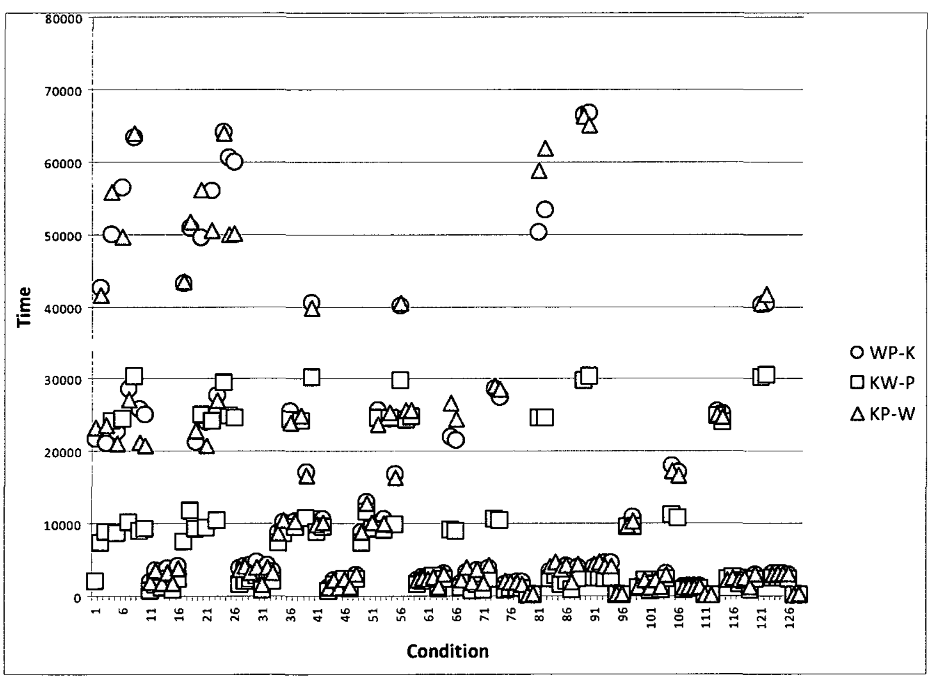

Figure 28. Means Comparison for WP-K, KW-P and KP-W (Time)

Time here can be seconds, and it can be weeks. In other words, time does not have a unit of measurement, so a person can take on average less time than another, yet not know how little. Effort, on the other hand, is measured in the number of mismatches among K, W, and P. However, it still serves a categorization purpose. Lastly, effort and time can be seen as measures of effectiveness and efficiency of the process of understanding: the less effort the more effective our understanding is, the less time the more efficient our understanding is.

As a final note, what the data provides are the observations of what was understood given an effort and time. Therefore, the baseline provided by the data, assuming that a person understands, is the difference between what was understood from different people depending on initial conditions.

4.5.1 QUALITATIVE ASSESSMENT

Figure 27 (see Appendix B for the corresponding data) shows that indeed there is an apparent common behavior for the three types of understanding in terms of effort. Two observations are made:

- The three types of understanding have a similar pattern when it comes to effort.
- In addition, four distinct levels are observed. Levels 1 to 3 are in the few thousands whereas level 4 is in the ten thousands. These levels need to be further explored.

Figure 28 (see Appendix C for the corresponding data) shows that the three types of understanding do not present a discernable pattern in terms of time as it is in terms of effort. However, observations can be made: in most cases KW-P takes less time than WP-K and KP-W. This needs to be explored.

Although there are three types of understanding that need analysis, it is noted that:

- One of the three types of understanding is going to be used for analysis in terms of effort. Although they may prove to be statistically different, for simplification purposes, they are considered the same. The analysis of the other two is conducted on the need to basis.
- KP-W is selected for the analysis of the data. This is because it is the one with the most normally distributed initial conditions or approximately normally distributed out of the three (see Table 2). P-values need to be > = 0.05 to not reject the normality assumption. This assumption must be assessed to perform parametric analysis.
- Analysis of time is to be conducted on the need to basis as a complement of to the analysis of effort because, unlike effort, time does not present an apparent overall pattern that can guide the analysis.

Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W
1	0.44	0.15	0.13	33	0.04	0.14	0.06	65	0.34	0.09	0.44	97	0.29	0.06	0.01
2	0.02	0.66	0.62	34	0.13	0.86	0.45	66	0.22	0.09	0.04	98	0.11	0.07	0.22
3	0.73	0.11	0.08	35	0.11	0.03	0.03	67	0.03	0.36	0.12	99	0.07	0.32	0.08
4	0.01	0.78	0.97	36	0.96	0.95	0.97	68	0.79	0.92	0.12	100	0.64	0.63	0.18
5	0.8	0.06	0.06	37	0.16	0.23	0.16	69	0.42	0.35	1	101	0.53	0.03	0.3
6	0.01	0.85	0.97	38	0.8	0.92	0.95	70	0.32	0.72	0.97	102	0.56	0.54	0.84
7	1	0.01	0.01	39	0.02	0.21	0.25	71	0.06	0.06	0.05	103	0.13	0.03	0.09
8	0.47	0.65	0.99	40	0.91	0.66	0.61	72	0.92	0.83	0.34	104	0.92	0.29	0.45
9	0.03	0.16	0.47	41	0.01	0.12	0.16	73	0.05	0.14	0.45	105	0.01	0.1	0.04
10	0	0.06	0.13	42	0.38	0.15	0.1	74	0.1	0.03	0.35	106	0.05	0.21	0.05
11	0.65	0.12	0.24	43	0.15	0.81	0.39	75	0.26	0.01	0.23	107	0.11	0.1	0.05
12	0.43	0.97	0.35	44	0.56	0.91	0.47	76	0.16	0.08	0.03	108	0.29	0.1	0.1
13	0.09	0.15	0.05	45	0.03	0.02	0.23	77	0.04	0.03	0.12	109	0.77	0.25	0.08
14	0.99	0.57	0.35	46	0.77	0.45	0.49	78	0.04	0.09	0.09	110	0.08	0.2	0.05
15	0.03	0.06	0	47	0.08	0.01	0.27	79	0.02	0.12	0.19	111	0.21	0.03	0.04
16	0.97	0.81	1	48	0.93	0.91	0.74	80	0.97	0.96	0.92	112	0.55	0.77	0.61
17	1	0.95	0.34	49	0.97	0.73	0.98	81	0.16	0.88	1	113	0.33	0.98	0.57
18	0.4	0.76	0.59	50	0.81	0.78	0.5	82	0.52	0.82	1	114	0.92	0.82	0.96
19	0.16	0.01	0.12	51	0.31	0.05	0.02	83	0.82	0.59	0.26	115	0.69	0.49	0.91
20	0.76	0.95	0.98	52	0.98	0.99	0.32	84	0.82	0.63	0.7	116	0.9	0.93	0.56
21	0.02	0.19	0.25	53	0.03	0	0.06	85	0.78	0.85	0.97	117	0.8	0.54	0.68
22	0.98	0.99	0.49	54	0.92	0.48	0.96	86	0.89	0.73	0.88	118	0.92	0.92	0.96
23	0.05	0.08	0.11	55	0.07	0.04	0.05	87	0.06	0.45	0.23	119	0.31	0.28	0.02
24	0.97	0.92	0.8	56	0.53	0.97	0.98	88	0.95	0.89	0.83	120	0.99	0.69	0.96
25	0.44	0.96	0.93	57	0.37	0.53	0.97	89	0.94	0.94	0.9	121	0.98	0.82	0.36
26	0.45	0.85	0.7	58	0.42	0.67	0.97	90	0.52	0.84	0.85	122	0.66	0.93	0.11
27	0.33	0.92	0.1	59	0.94	0.52	0.89	91	0.96	0.52	0.85	123	0.08	0.29	0.69
28	0.97	0.56	0.87	60	0.75	0.95	0.49	92	1	0.67	0.49	124	0.92	0.23	0.48
29	0.98	0.89	0.83	61	0.69	0.36	0.18	93	0.68	0.97	0.77	125	0.9	0.88	0.75
30	0.44	0.95	0.89	62	0.95	0.74	0.77	94	0.71	0.85	0.75	126	0.78	0.83	0.54
31	0.26	0.04	0.1	63	0.8	0.67	0.06	95	0.88	0.81	0.82	127	0.95	0.28	0.42
32	0.33	0.37	0.57	64	0.84	0.89	0.48	96	0.73	0.91	0.99	128	0.81	0.68	0.33

Table 2. Kolmogorov-Smirnov Normality Test for WP-K, KW-P, and KP-W (p-values)

4.5.2 QUANTITATIVE ANALYSIS

In the qualitative assessment it is found that, when referring to effort, there seems to be levels as observed in Figure 29. It was found that what apparently looked like four levels are instead seven. Levels 1 to 4 are shown in Figure 29. Level 1 is located between values 0 and 50, level 2 between values 150 and 250, level 3 between values 250 and 350, and level 4 between values 500 and 600 for all three types of understanding.

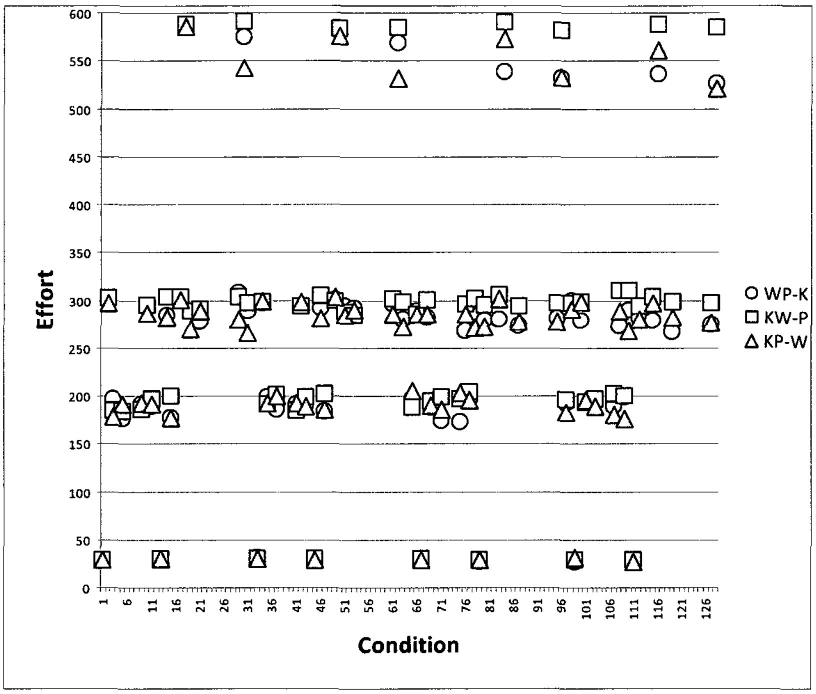

Figure 29. Levels 1, 2, 3, and 4 (Effort)

Figure 30 shows levels 5 and 6. Level 5 is located between values 1500 and a little over 2000 and level 6 with values between 3000 and 4000 for all three types of understanding. It is noted that while variation in levels 1 to 4 is in the few tenths, variation in levels 5 and 6 are in the hundreds. Figure 31 shows level 7 which for all three levels varies in the tens of thousands.

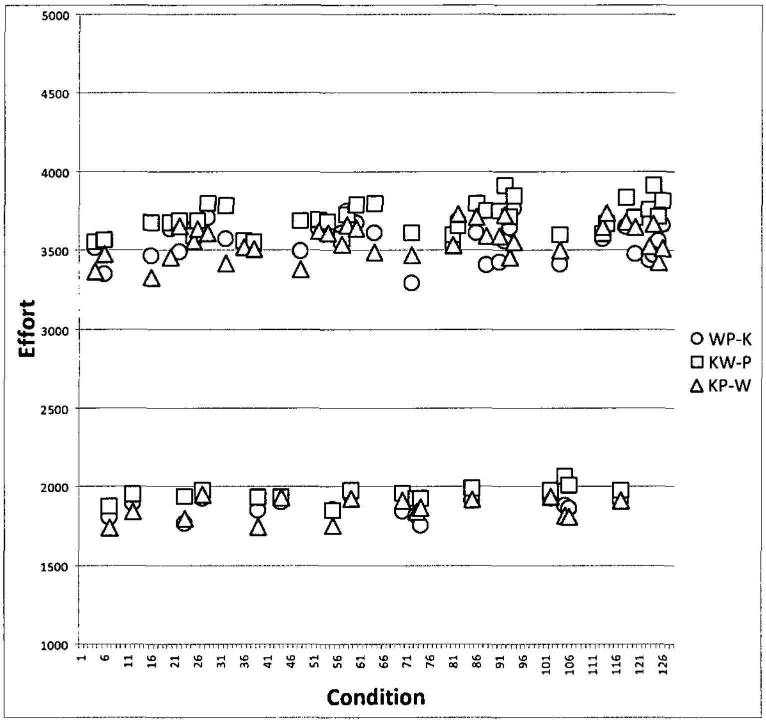

Figure 30. Levels 5 and 6 (Effort)

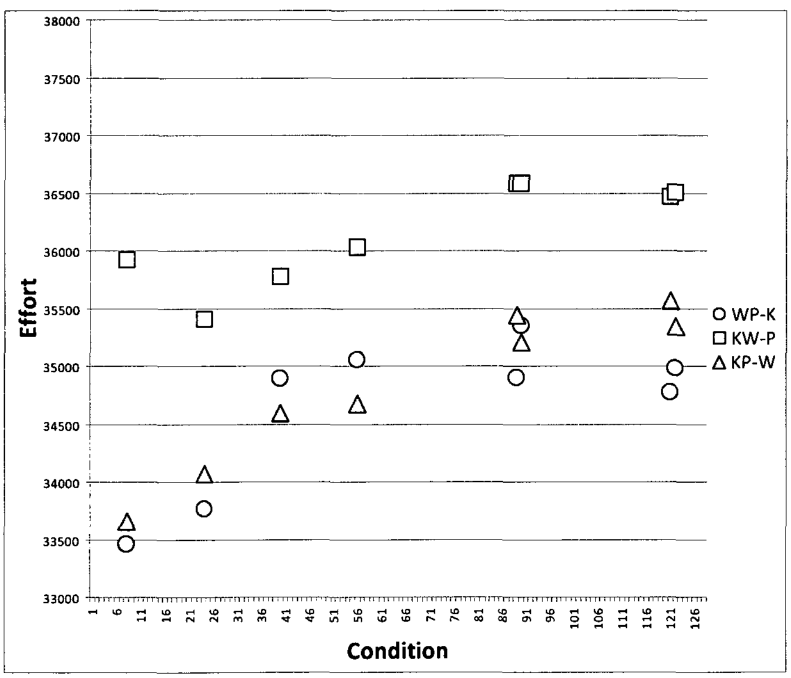

Figure 31. Level 7 (Effort)

To study these levels, comparison of means was conducted using one-way ANOVA. ANOVA or analysis of variance uses the F-test to test the hypothesis concerning the means of three or more populations. Here, ANOVA is used to compare the means of three or more samples.

Level 1

Table 3 shows the initial conditions for level 1.

Condition\Factor	K_α	K_β	W_α	W_β	P_α	P_β	WO
1	L	L	L	L	L	L	L
13	L	L	H	H	L	L	L
33	L	L	L	L	L	L	H
45	L	L	H	H	L	L	H
67	H	H	L	L	L	L	L
79	H	H	H	H	L	L	L
99	H	H	L	L	L	L	H
111	H	H	H	H	L	L	H

Table 3. Level 1 Initial Conditions

A Levene test for homogeneity of variances was conducted (Table 4) for level 1. This test says that variances are not homogeneous. No homogeneity can be due to condition 111 because its data are not distributed normally (p=0.04). Moreover, the significance value of 0.01 of the F test suggests that means of the eight conditions are not comparable (Table 5).

Test of Homogeneity of Variances

Effort

Levene Statistic	df1	df2	Sig.
2.489	7	1992	.015

Table 4. Levene Test for Level 1

ANOVA

Effort

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2731.580	7	390.226	3.587	.001
Within Groups	216680.1	1992	108.775		
Total	219411.7	1999			

Table 5. F Test for Level 1

Figure 32 shows the plot of the means for level 1.

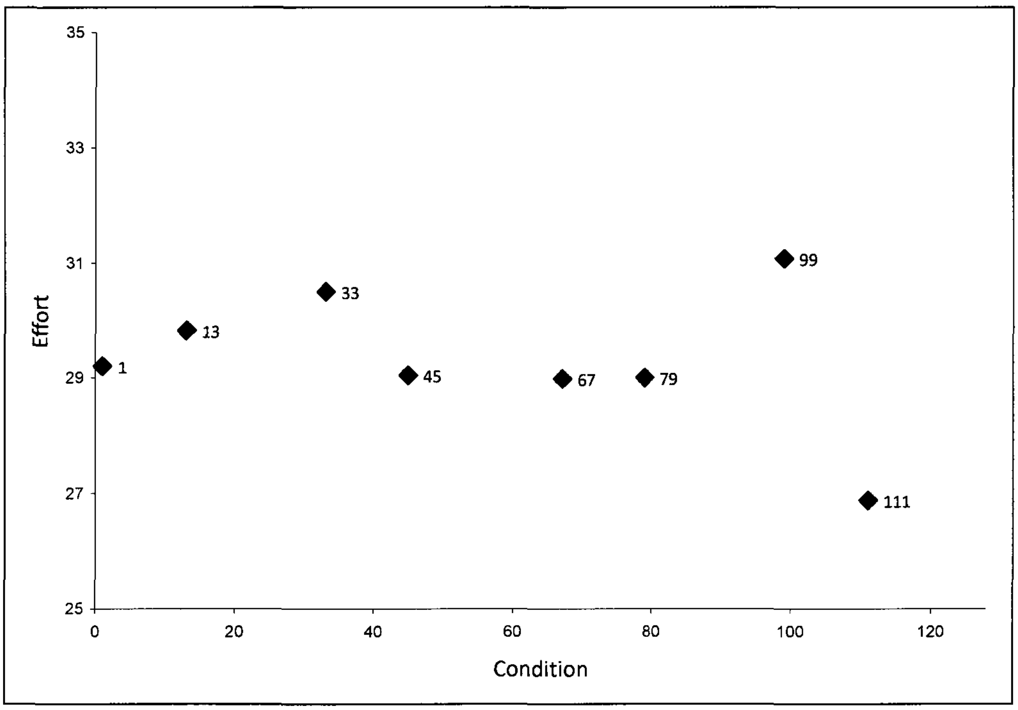

Figure 32. Plot of Means for Level 1 (Effort)

It can be observed that condition 111 is the one that presents a mean that seems extreme compared to the rest. It is noted that data transformation was not conducted in condition 111 because it would still not be able to compare it to the other conditions given that the mean will be dramatically different. Table 6 shows the Levene test for conditions 1, 13, 33, 45, 67, 79, and 99. Now that their variances are homogeneous, ANOVA can be used. The F test for these conditions gives a $p = 0.158$ which suggests that conditions at level 1, excluding condition 111, are not statistically different (Table 7).

Test of Homogeneity of Variances

Effort

Levene Statistic	df1	df2	Sig.
1.805	6	1743	.094

Table 6. Levene Test for Level 1 (Excluding Condition 111)

ANOVA

Effort

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1040.992	6	173.499	1.551	.158
Within Groups	195003.7	1743	111.878		
Total	196044.7	1749			

Table 7. F Test for Level 1 (Excluding Condition 111)

According to the data, condition 111 should not be considered within level 1. However, given that there is no other sublevel, it is considered within level 1 for assessment.

Level 1 low effort is due to the low level of problem (both P_α and P_β) combined with either high or low level of both knowledge (both K_α and K_β) and worldview (both W_α and W_β). It is noted the uniformity of knowledge and worldview on either high or low levels. This means that no combination of high and low knowledge or high and low worldview is present.

The fact that the means at this level are not statistically different provides insight into a common preconception: more knowledge implies better understanding. Based on the data:

- Looking at conditions 1 and 67, they are statistically equivalent; they have low and high knowledge levels respectively keeping worldview, problem, and WO at same levels. In other words, *more knowledge does not imply less effort (better understanding)*. It is noted that "better understanding" is seen here in terms of effort.
- More worldview does not imply better understanding, in terms of effort (see conditions 1 and 13).
- Finally, a high setting on WO does not imply better understanding, in terms of effort. When comparing conditions 67 and 99 and conditions 13 and 45 it can be seen that they are statistically equivalent. It is noted that all these assessments are made at level 1.

The previous bullets give us insight into one important aspect: *better understanding*. Better understanding, in this case, is inferred from all different conditions. In other words, given a problem perception and WO of the problem, the best setting combination of knowledge and worldview to achieve understanding with less effort can be found when looking at the tables of the different levels and the corresponding output.

Although conditions in level 1 have comparable means in terms of effort, in terms of time they do not. In order to compare means in terms of time, normality tests for all conditions are needed (see Appendix E). It can be observed from the normality test for time that most conditions are not normally distributed, so ANOVA cannot be used. Instead, the Kruskal-Wallis non-parametric test is used. The Kruskal-Wallis test is used when the assumption of normality does not hold. Table 8 shows the Kruskal-Wallis test when comparing conditions for level 1.

Test Statistics[a,b]

	Time
Chi-Square	1369.854
df	6
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: Condition

Table 8. Kruskal-Wallis Test for Level 1 (Time)

The test shows the asymptotic significance that estimates that the probability of obtaining a chi-square statistic greater than or equal to the one displayed if there truly is no difference between the group ranks. In this case, a chi-square of 1369.854 with 6 degrees of freedom should occur about 0 times per 1000. In other words, conditions within level one are statistically different. It is noted that the test was run without condition 1 given that it was a value that could skew the analysis (see Figure 33).

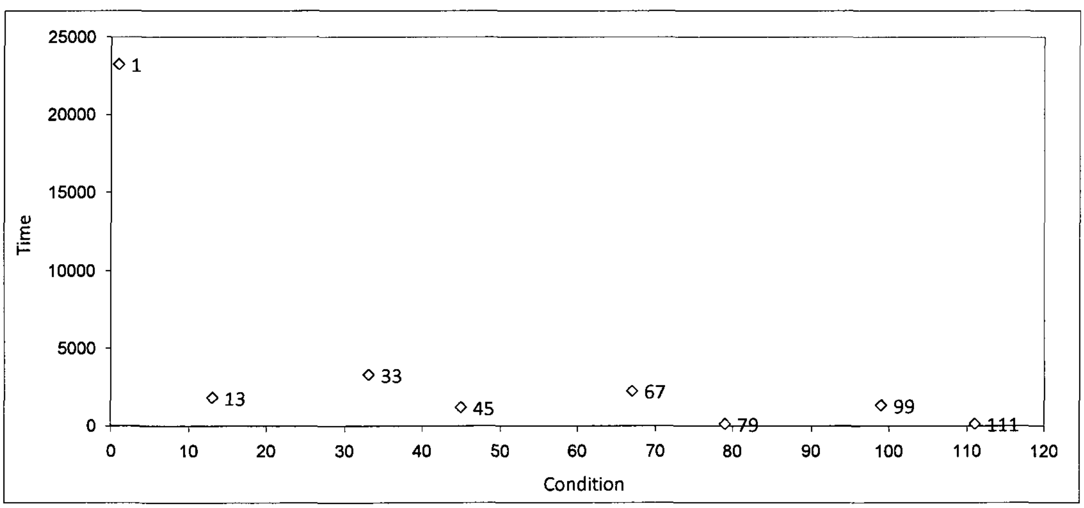

Figure 33. Plot of Means for Level 1 (Time)

Figure 33 provides three important insights:

- The positive impact of worldview is evident when comparing conditions 1 and 13 showing that it reduces the time needed to understand. The same can be said about the effect of knowledge when comparing conditions 1 and 67. Although intuitively it could be considered that condition 1 is the most unfortunate condition, given low levels of everything, it is not the one that takes the longest to understand across levels.
- Further, when comparing condition 45 and 99, the effect of high worldview is very similar to the effect of high knowledge when problem and WO are at high settings (1223 and 1333 time units respectively). Conditions 13 and 67 are "close enough" (1818 and 2224 respectively) serving to speculate the effect of worldview and the effect of knowledge are similar when WO is low.
- Comparing table 5 and figure 35, it is observed that more knowledge and/or more worldview speed up the understanding process at this level.

Table 9 shows a Mann-Whitney U test comparing conditions 45 and 99 that confirms the suspicion that high knowledge and high worldview, when the problem is at low and WO is at high setting, are equivalent. Mann-Whitney U test is used because these conditions are not normally distributed. Table 10, on the other hand, proves the suspicion that conditions 13 and 67 are equivalent under the same knowledge, worldview, and problem settings, with WO at low level.

Test Statistics[a]

	VAR00001
Mann-Whitney U	28513.500
Wilcoxon W	59888.500
Z	-1.694
Asymp. Sig. (2-tailed)	.090

a. Grouping Variable: VAR00002

Table 9. Mann-Whitney U Test comparing Conditions 45 and 99 (Time)

Test Statistics[a]

	VAR00001
Mann-Whitney U	11638.000
Wilcoxon W	43013.000
Z	-12.141
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: VAR00002

Table 10. Mann-Whitney U Test comparing Conditions 13 and 67 (Time)

The effect of WO still needs to be evaluated in terms of time. It was shown that in terms of effort, it does not make a difference high or low WO. Comparing conditions 67 and 99 (same settings, but different WO) the Mann-Whitney U test shows that the two conditions are not statistically equivalent (Table 11). In other words, WO makes a difference in terms of time.

Test Statistics[a]

	VAR00001
Mann-Whitney U	11638.000
Wilcoxon W	43013.000
Z	-12.141
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: VAR00002

Table 11. Mann-Whitney U Test comparing Conditions 67 and 99 (Time)

The same can be said when comparing conditions 79 and 111 (Table 12).

Test Statistics[a]

	VAR00001
Mann-Whitney U	17809.500
Wilcoxon W	49184.500
Z	-8.321
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: VAR00002

Table 12. Mann-Whitney U Test comparing Conditions 79 and 111 (Time)

Finally, note that although more knowledge and/or worldview in terms of effort do not mean better understanding, in terms of time apparently they do. However, note that, as it was previously mentioned, time is not the best variable to use for comparison within a level given that it does not abide by the same pattern as effort. One situation could be that condition 1 is better compared to another condition on a different level. This is explored later in the document.

Now, assessing whether the three types of understanding are equivalent to one another in level 1, as it is suggested by observation 1 (in terms of effort), presents a difficulty, which spawns from the normality of the data on WP-K and KW-P. Whereas for KP-W only condition 111 is not normally distributed, conditions 33, 45, 67, and 79 are not normally distributed as well for either WP-K or KW-P. Figure 34 shows the means for level one for the three types of understanding.

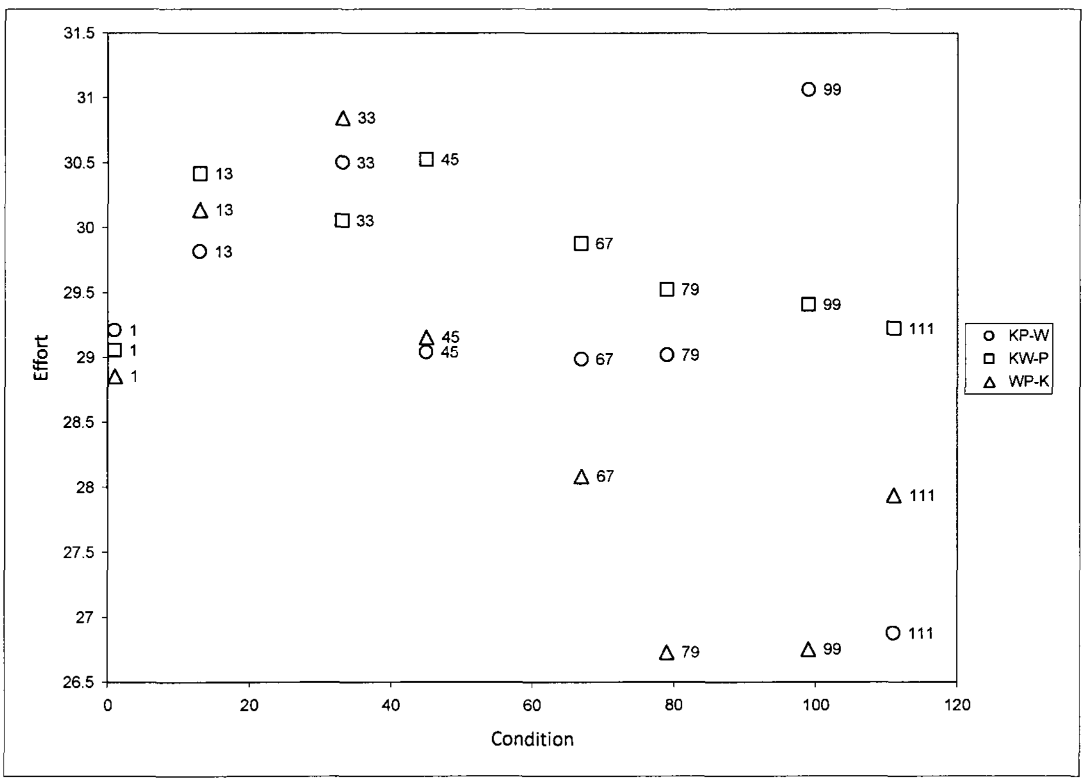

Figure 34. Comparison of Means of KP-W, KW-P, and WP-K at Level 1 (Effort)

The data were not transfomed because at least one of the three types had a condition normally distributed. However, Figure 34 could be used to speculate, based on the data, and draw a conclusion:

- Depending on the condition, whereas some of the three types of understanding are equivalent, there are others were one type is better than the other. For instance, conditions 79 and 99 clearly show a major advantage of WP-K over its counterparts, in terms of effort. This advantage is not as obvious in conditions 1 and 13 for instance.

This speculation can be confirmed by comparing conditions 1, 13, and 99 for the three types of understanding. These conditions are the only ones, common to the three types that are normally distributed. Appendix F shows the test results when comparing conditions 1, 13 and 99 respectively for the three types (Levene and F-Tests).

For conditions 1 and 13 the F test shows that the three types of understanding are statistically equivalent showing that one type is not better than the other. On the other hand, condition 99 shows that the three are not statistically equivalent, but KP-W and KW-P are. In addition, the mean of WP-K is significantly lower than its counterparts.

The Tukey HSD (honestly significant difference) test compares condition 99 for the three types of understanding and shows the equivalence of KP-W and KW-P (type 1 and 2 respectively in Table 13). By type 3 (WP-K) having the lowest value and being statistically different from KP-W and KW-P, it can be concluded that WP-K takes less effort than its counterparts for condition 99.

Effort

	Type	N	Subset for alpha = .05 1	2
Tukey HSD[a]	3	250	26.7560	
	2	250		29.4080
	1	250		31.0640
	Sig.		1.000	.192

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 250.000.

Table 13. Tukey HSD Comparing Condition 99 for KP-W, KW-P and WP-K at Level 1

A possible explanation of why WP-K is better than its counterparts lies in the availability of knowledge when WP-K takes place. For WP-K, when problem and worldview are at low settings, there is an abundance of K for the matching when the problem is being formulated (WP), whereas for KP-W and for KW-P there is a low availability of W. The low setting of W has an impact when it is needed for KP and when K needs to be formulated (KW). This result is counterintuitive because one would expect that the types that benefit the most from high settings of knowledge are KP-W and KW-P, not WP-K. In addition, WP-K has the added benefit of a high WO that KP-W cannot capitalize on.

Another interesting point for discussion is condition 111. This condition shows that KP-W is better than WP-K and WP-K is better than KW-P despite high settings of K and W. Given that condition 111 is not normally distributed, a non-parametric test is used to compare two types of understanding at the time. When comparing KP-W and KW-P, a Mann-Whitney U test shows that they are different ($p<0.05$) as seen in Table 14.

Test Statistics[a]

	VAR00001
Mann-Whitney U	27428.000
Wilcoxon W	58803.000
Z	-2.367
Asymp. Sig. (2-tailed)	.018

a. Grouping Variable: VAR00002

Table 14. Mann-Whitney U comparing Condition 111 for KP-W and KW-P

However, when comparing KP-W with WP-K and WP-K with KW-P, they are statistically equivalent according to the same test (Table 15 and Table 16 respectively). It seems counterintuitive that KP-W is better than KW-P if K and W are at high settings. The explanation is the same as in the previous case. There is an abundance of W for KP-W when needed. KW-P is the worst because the abundance of both knowledge and worldview increases the chances for mismatch generating more not-understanding.

Test Statistics[a]

	VAR00001
Mann-Whitney U	28639.500
Wilcoxon W	60014.500
Z	-1.617
Asymp. Sig. (2-tailed)	.106

a. Grouping Variable: VAR00002

Table 15. Mann-Whitney U Test comparing Condition 111 for KP-W and WP-K

Test Statistics[a]

	VAR00001
Mann-Whitney U	29819.000
Wilcoxon W	61194.000
Z	-.886
Asymp. Sig. (2-tailed)	.375

a. Grouping Variable: VAR00002

Table 16. Mann-Whitney U Test comparing Condition 111 for KW-P and WP-K

Two important conclusions can be drawn so far:

- Although the three types of understanding are equivalent, it remains to be shown if it is the general case. It is shown that each condition must be evaluated to establish which type is better.
- In addition, it is not necessarily about what factor, knowledge, worldview, problem or WO, is high or low. It is about the combination of factors when they are at high or low settings. This is the reason why each condition must be evaluated independently when comparing KP-W, KW-P and WP-K.

Assessing whether the three types of understanding are equivalent to one another in terms of time presents a major challenge because, unlike the analysis of effort, time distributions are not normally distributed in their great majority (see Appendix E).

As with effort, we can draw speculations based on the data. Figure 35 shows the means for level one for the three types of understanding in terms of time.

It can be observed that the three types have a similar overall behavior with the exception of condition 1. It is noted that although overall behavior is similar, at the condition level it may be very different given issues of the scale of the axis used in the graph. This is shown in Figure 36 where most means may not be comparable. However, it can be observed that in most conditions KW-P performs faster than the other two types.

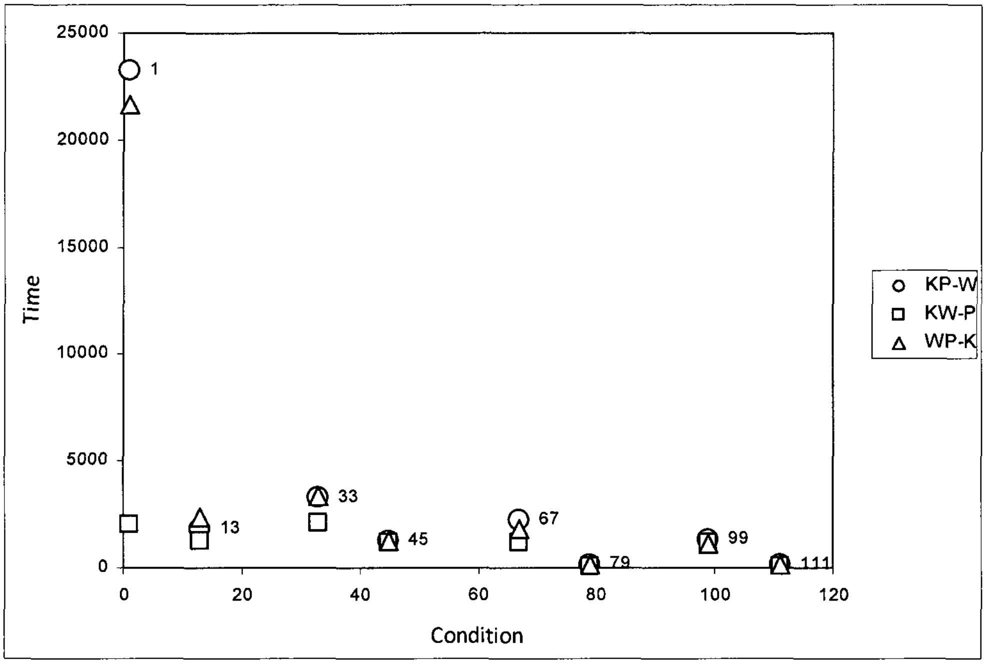

Figure 35. Comparison of Means for KP-W, KW-P, and WP-K at Level 1 (Time)

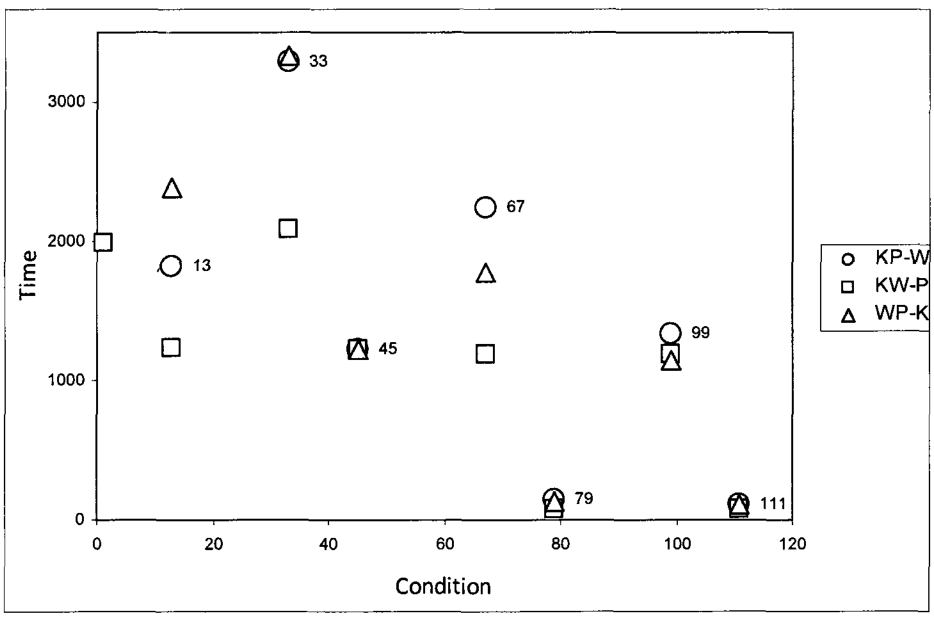

Figure 36. Comparison of Means for KP-W, KW-P, and WP-K at Level 1 (Scaled 1)

Comparing condition 67 for the three types of understanding KP-W, KW-P, and WP-K , the Kruskal-Wallis Test shows that the three types are not statistically equivalent (Table 17). From the graph, it can be concluded that KW-P performs better than its counterparts. On the other hand, when comparing the three types for condition 45, the Kruskal-Wallis Test shows that they are statistically equivalent (Table 18). For this condition, their performance is equivalent.

Test Statistics[a,b]

	Time
Chi-Square	224.206
df	2
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: Type

Table 17. Kruskal-Wallis Test for Condition 67 (Time)

Test Statistics[a,b]

	Time
Chi-Square	.896
df	2
Asymp. Sig.	.639

a. Kruskal Wallis Test

b. Grouping Variable: Type

Table 18. Kruskal-Wallis Test for Condition 45 (Time)

This concludes the analysis of level 1[4].

4.6 THEORY BUILDING FROM DATA ANALYSIS

Generalizing from the data, it is shown that an individual's effort to understand always converges to one of seven levels. This is an emergent output. Out of 128 different initial

[4] The remainder of the data analysis can be found in Appendix D.

conditions representing at least 128 different individuals only seven levels of effort emerged. 128 conditions are due to combinations of knowledge, worldview, problem, and time constraint. Given that effort is seen as the difficulty of a problem to be understood by a particular individual, it makes sense to establish that the higher the effort the more complex the person considers the problem. In other words, levels of effort can be seen as subjective levels of complexity.

These levels are not equidistant from one another. Level 6 is greater than level 5, but level 7 is much greater than level 6. This implies that an individual at level 7 will have much more difficulty understanding a problem than an individual at level 5, for instance.

What makes one level more complex for one individual than another is the alignment and balance of knowledge and worldview types with respect to problem type. It is about the number of the three types of statements when matched. Succinctly, when comparing two levels or conditions across levels, one should look at each initial condition given that the number of statements may increase the chances of mismatching. This is shown in Table 19.

Level	K-Alpha	K-Beta	W-Alpha	W-Beta	P-Alpha	P-Beta	Example
3	High	High	Low	High	Low	High	C108: K_α, K_β, W_β / P_β
5a	High	Low	Low	High	Low	High	C106: K_β, W_β / P_β
5b	High	Low	Low	High	Low	High	C12: K_α, W_β / P_β
7	High	Low	High	Low	Low	High	C8: K_α, W_α / P_β

Table 19. Balance of Statements

Considering alignment, comparing level 7 with level 5b, for instance, it is observed that having W_β instead of W_α reduces the level of effort (less mismatching among the three types of statements). However, comparing level 5b and 5a (two conditions within the same level), changing K_α for K_β does not make a difference. Yet adding K_α, a reduction of effort is observed. This is due to balance. K_α, even though it does not compensate for P_β, it does compensate for P_α despite their low numbers. The concept of alignment and balance also suggest that one level is not more complex than another because of how high or how low the number of statements is. Level 4, for instance, presents high numbers of P_α and P_β with low and high numbers of K_α, K_β, W_α, and W_β. Yet, there are another three levels, above and below, where more and less effort is required to understand.

Alignment explains why systems engineering, for instance, is considered to be better addressed by knowledge about structure with worldview about structure. However, it also highlights the need to balance knowledge and worldview about structure with knowledge or worldview about behavior. This insight also suggests that the systemic idea that more elements imply more complexity, within understanding, is not the general case. When something has few elements and yet difficult to understand explains why emergence is difficult to predict and understand. In this case, complexity is not about the number of parts, but about their emergent behavior and the knowledge and worldview to recognize that emergence. If seen by the number of parts, problems with many parts are considered extremely complex. However, if the problem is looked by the emergence of the parts, the problem becomes simple.

Another insight is about the common idea that more knowledge implies more understanding. Data show that this is not the case. Level 1 and level 4 show that under same problem conditions, effort does not decrease due to higher knowledge and/or worldview. All reduces to the concept of alignment and balance.

Insight this far has been gathered from analysis of effort to understand on one type of understanding (mostly KP-W). Time to understand and comparing types of understanding (KP-W, KW-P, and WP-K) provide three main insights. The first is that higher time does not necessarily imply higher effort. In other words, because a person takes longer to understand, does not mean that it requires more effort. This sounds counterintuitive. However, this is due to a low number of statements that need to be matched. Nonetheless, the problem is still considered complex by that individual because it took a long time to be understood. Time then becomes a factor of why a problem may be considered more complex for one individual than for another. This case can be observed in condition 4 in level 6. Conversely, less time does not necessarily imply less effort. This can be observed in condition 24 in level 7. The second insight states that unlike effort, a larger number of the three types of statement imply less understanding time. Further, given that KP-W and WP-K depend on time restrictions, more time implies faster understanding. This is not the case for KW-P as it does not depend on time. The third insight relates to the fact that one type of understanding may be better than another depending on the initial conditions. For instance, KW-P in most cases performed better in terms of time than its counterparts. However, in most cases it performed worse in terms of effort compared to its counterparts. Condition 8 in level 7 shows this case. This shows that an individual should consider, besides the initial condition, the type of understanding it uses in order to better understand.

Considering effort and time, and also by the comparison of the three types of understanding it is shown that understanding can be subjectively quantified. This is possible in the ideal case where the number of statements of knowledge, worldview, and problem can be quantified as well. An individual may be able to predict the amount of time or effort it takes to understand a problem. Further, the individual could also predict which type of understanding is better depending on the problem at hand, considering available knowledge and worldview.

Finally, if an individual were to consider effort, time, and type of understanding, it may be able to pinpoint conditions where understanding is easier or more difficult to achieve. In other words, a combination of such elements could lead to better understanding which consequently leads to less complexity.

4.7 SUMMARY OF TOWARDS A GENERAL THEORY OF UNDERSTANDING

This section presented an initial general theory of understanding (GTU). It is called general because it explains the two existing schools of understanding found in the body of knowledge. In addition, it shows a new third school of thought. To build the GTU, insight from a built axiomatic structure and insight from data are used. The axiomatic structure provides a precise way of defining understanding through the definition of terms such as knowledge, worldview, and problem. In addition, a theoretical representation of the axiomatic structure is provided in the form of the Understanding Construct (UC). Through the use of the UC a simulation is created. Data are obtained from the simulation insights drawn. Using effort to understand as a metric, it is shown that different individual profiles converge to only seven levels of effort to understand. Levels of effort show that individuals consider problems more complex at higher levels than at lower levels. Consequently, understanding contributes to a problem being more or less complex. Figure 37 shows some of the main contributions of this work to the body of knowledge (BOK).

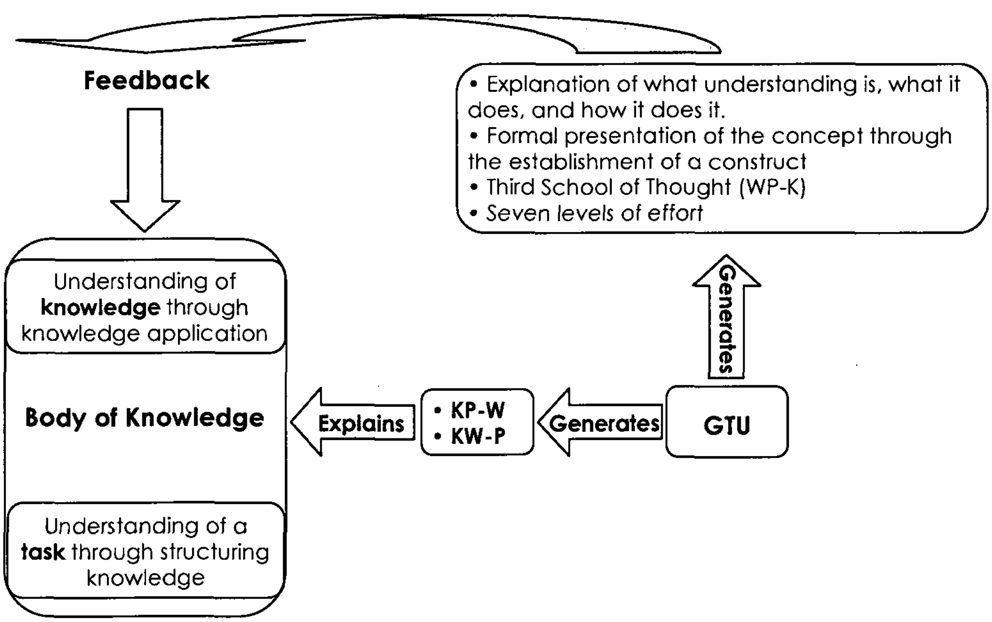

Figure 37. Contribution of General Theory of Understanding to BOK

5 DERIVED THEORETICAL IMPLICATIONS

Understanding's overarching umbrella covers a wide spectrum of individuals encompassing scientists, politicians, and regular people. When scientists do research, they match their knowledge to problems under a particular worldview. The worldview, in this case, becomes their form of justifying their scientific endeavors. When politicians propose reforms, they match their knowledge to constituents' problems under the worldview of their political party which in terms is supported by their own. Regular people's process of understanding is no different from scientist or politicians. There is still the same process of matching knowledge and worldview to day-to-day problems. The concept of understanding is one of the few that has many ramifications on day to day life.

Figure 38 shows how the GTU provides insights not only about the phenomenon of understanding itself, but also how this phenomenon affects areas of interest to Engineering Management (EM). In terms of the concept of understanding, it contributes to the BOK by providing an explanation about the phenomenon. Areas of interest to EM, such as complexity and decision, benefit from this work by having understanding as a common thread.

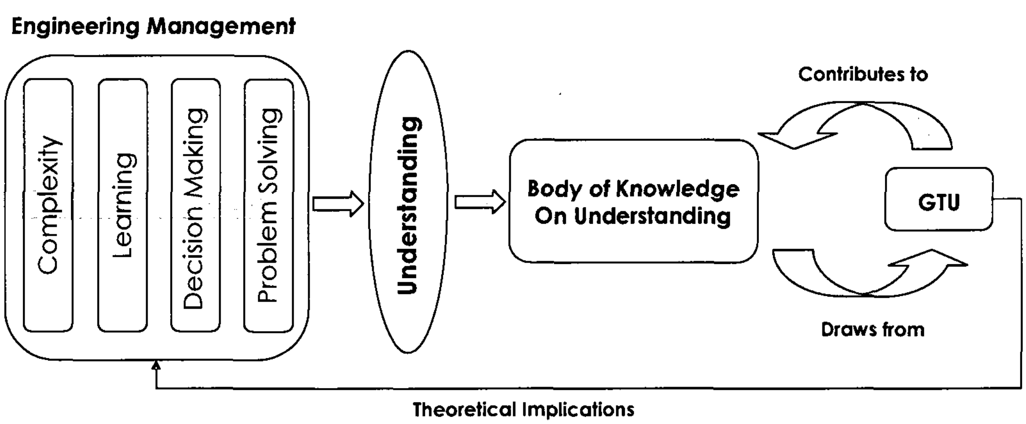

Figure 38. Theoretical Implications of the GTU

Some of the main accounts of the different areas where this work has an impact are presented in the following sections.

5.1 ON UNDERSTANDING

An unambiguous concept of understanding was proposed by providing a set of formalized bases. The concept allows the researcher to answer four basic questions: What is understanding? What does understanding do? How does understanding do what it does? Why does understanding do what it does? The answers to these questions are:

- As a process, understanding *is* the matching of knowledge, worldview, and problem.
- As an output, understanding *is* the result of the assignment of a truth value to a problem.
- Understanding *does* assign truth values to problems.
- The process of the matching, *how*, occurs in one of three forms: KP-W, understanding a problem through knowledge application; KW-P, understanding a problem through knowledge formulation; and WP-K, understanding a problem through the formulation of the problem.
- Understanding assigns truth values to problems *because* it creates knowledge.

Ontologically, understanding is presented as a duality by providing process and substantive perspectives. This covers the two predominant perspectives in the body of knowledge when describing understanding.

Understanding provides the creation of knowledge and worldview. Understanding creates knowledge because when problems are assigned truth values, by definition, they become knowledge. This has a direct impact in Knowledge Management (KM) where the Knowledge Conversion process (Nonaka & Takeuchi, 1995) is widely accepted as a knowledge creation process. Understanding creates worldview because what was understood can be communicated through an explanation. An explanation is a statement about statements which by definition is a worldview. This presents understanding not only as a knowledge creation process, but also as a worldview creation process. Worldview is not considered within the definition of understanding given that, in the general case, it cannot be assessed. Understanding as a worldview creation process is of particular importance given that in the body of knowledge there is no indication of a particular process that generates worldview. Further, the consideration of understanding as a knowledge creation process, although intuitively correct, can now be explained based on the definitions provided. It is important to note that knowledge created through understanding would not abide by epistemology's definition of knowledge as justified true belief from a correspondence point of view. This is because knowledge, when created by understanding under this model, has not been externally justified and truthfulness has not been evaluated. However, it does fulfill the definition of justified true belief from a coherent point of view given that it is only the understanding of one person. That individual builds a system of premises out of the matching of its knowledge, worldview, and problem.

Assessment of what was understood is sought after in the body of knowledge. However, it is always under the assumptions of objectivity and a knowable problem. Within a problem situation, by definition, nothing can be objectively defined or completely known given different understandings and reality limitations. A basic subjective evaluation of what was understood is simply the yes/no answer to the questions, "Did you understand?", "Did you not understand?" or "Were you able to understand?" Misunderstanding cannot be evaluated within a problem situation either. By definition, misunderstanding is the number of statements with wrongly assigned truth values out of the ones that needed assignment. Misunderstanding can be evaluated then within an objectively defined problem with a known solution.

Another important implication of the theory, relates to appropriateness. Unlike the perspective suggested in Moore and Newell (1974) whose consideration of appropriateness of understanding is only when the resulting assignment of truth value is true, this theory considers when the assignment is false. This says that not-understanding is a form of understanding where the individual is aware that it did not understand. This is consistent with Nickerson (1988) when he says that "awareness of ignorance – at one level can be evidence of understanding at another level." Besides appropriateness, other three conditions of understanding were defined: existence, capacity, and relevance. These are also of great importance. If one of the main *components, problem, knowledge, or worldview, is missing then the person is not able* to understand. Not being able to understand is different from not-understanding. In the former, understanding or not-understanding will not be achieved for any of three reasons: a problem was not perceived, there is no knowledge that is relevant to the problem, or there is no worldview relevant to the problem. It is emphasized that understanding as well as not-understanding depend on all three at the same time: knowledge, worldview, and problem.

A person can, for instance, have knowledge and not understand a problem. This is because at the very least, the person must have had understood relevant knowledge to the problem first. The subjective test case here is to say that if a person understood a problem then at least the knowledge used to understand the problem is also understood.

5.2 ON SHARED UNDERSTANDING

Considering two individuals at different effort levels, an individual at level 1, for instance, may believe that s/he understood better than someone at level seven. In a group dynamic the first individual may judge itself better able to understand a problem at hand than the second one. However, this is not necessarily the case because individuals are departing from different problem formulation, knowledge base, and worldview base. Therefore, what it was understood cannot be objectively assessed and much less compared. This lack of assessment and consensus, typical of problem situations, may not only be about social problems. For instance, if an individual is understanding a problem about behavior, it is agreed in the body of knowledge that consensus with another individual is very unlikely because of the nature of the problem. Data show that even if the problem is about structure, when individuals are at extreme levels of effort, reaching a consensus seems to be extremely difficult. Different worldview and knowledge are at play when a person is understanding a problem. Consensus implies that worldview and knowledge among individuals, even when it relates to problems about structure, need to be the same. Going even further, if one person is understanding a problem as a problem about behavior, while the other is understanding it as a problem about structure consensus is also very unlikely. This suggests that problem situations can be about technical problems when people refer to different solutions depending on their knowledge and worldview.

These arguments lead to the idea that problem situations may be about lack of shared understanding. This suggests that shared understanding is good but perhaps difficult to achieve.

In the hypothetical case, when an individual desires to develop a metric that assesses what was understood on a particular problem, conditions require the assessment to be bounded. Some basic conditions could be:

- Define statements (knowledge, problem, and worldview) for each individual involved in the problem.
- Assess the common ones.
- Allow individuals to match statements.
- Assess the types of understanding used.
- Compare explanations and knowledge generated.

In reality, generating this list is very unlikely. When referring to shared understanding, based on the proposed definitions, this is what individuals do. How it is done is not clear in this research. However, what it is clear is the extreme difficulty of achieving such a concept.

As with understanding, shared understanding is a commonly used concept yet its implications are overlooked. In order to have some degree of shared understanding, one must guarantee that, besides having common knowledge, problem, and worldview among the people involved, a common match must exist. In other words, if shared understanding is defined as the intersection of matching then the intersection cannot be an empty set.

Shared understanding, or lack thereof, can be blamed for many failed projects. From this perspective, assuming shared understanding among individuals assumes these individuals have a common knowledge base, common worldview base, and common perception of a problem. In addition, it assumes they share the way the three were matched. As it can be inferred, assumption of one may be damaging enough. On the other hand, considering that different worldview may be beneficial to make decisions, the question of whether shared understanding is beneficial to decision making needs to be formulated. This seemingly opposite view can be explained by differentiating consensus from shared understanding. Whereas consensus about decisions may be needed to enact decisions affecting a group, different understanding, or lack of shared understanding, may be the best output even if it hurdles consensus. This situation may be deemed acceptable in organizations when different individuals bring different perspectives and expertise to a discussion. In these situations, it is accepted that no one has full understanding about the situation at hand and that anyone may be right or wrong. This is characteristic of problem situations.

5.3 ON THE ROLE OF UNDERSTANDING IN COMPLEXITY

A major contribution of this work is the premise that highlights understanding as a key human component of complexity. Complexity is an issue of interest to systems engineers and project managers among others.

Within projects and in day-to-day activities, problems are understood differently by different people. This is especially true when it comes to problem situations. What this work suggests is a way of subjectively assessing complexity through understanding.

Using effort to understand as a metric, an individual is able to categorize how high or how low the difficulty of understanding the problem is. For instance, if knowledge elicitation techniques are extended to worldview and problem elicitation then such subjective evaluation is feasible by considering the types of statements (alpha or beta). In addition, it is feasible to assess how long it may take to understand such a problem. In both cases it is a probabilistic assessment based on the number of statements.

A metric could also be useful to better define strategies to improve understanding. If an individual is able to assess in which level of effort it is placed, strategies that allow it to move from higher to lower levels could also be devised. Among these strategies could be to target switching or acquisition of suitable worldview, switching or acquisition of suitable knowledge and even considering extending the scope of the problem to consider both problems about structure and behavior. Further, the strategies could also consider which type of understanding to use in order to make the process more efficient or possibly more effective.

It is safe to assume that some conditions for an individual, given a problem, are more conducive to understanding or to better understanding, than others. Trainers and decision makers may be interested in reducing the complexity of a problem for a particular individual. This leads to the design of strategies that, considering the same problem for an individual, it may be able to adjust into or gain new worldview, acquire or consider other existing knowledge. If this is the case, the goal is to decrease the level of effort that it takes for an individual to understand. This is the inverse situation to say, what conditions could lead an individual to better understanding.

From this perspective, trainers and decision makers, for instance, may be interested in focusing on assessing the number of statements an individual has reflecting amount of knowledge, worldview, and problem. More importantly, they may be interested on how to change these amounts to a desired level given the same problem for that individual. For instance, looking at conditions 8 and 12, it is shown that the individual needs to switch worldview to effectively move from level 7 to 5. Moreover, looking at conditions 12 and 108 the individual needs to acquire more experience to move from level 5 to 3. Table 20 shows the previously mentioned example.

Level	K-Alpha	K-Beta	W-Alpha	W-Beta	P-Alpha	P-Beta	Example
3	High	High	Low	High	Low	High	C108: K_α , K_β , W_β / P_β
5	High	Low	Low	High	Low	High	C12: K_α , W_β / P_β
7	High	Low	High	Low	Low	High	C8: K_α , W_α / P_β

Table 20. Reducing Complexity through Better Understanding

In this example, condition 8 has a high number of known statements about structure (K_α), and a high number of statements about structure about statements (W_α) on a high number of unknown statements about behavior (P_{β})). To move from level 7 to level 5 it is at least required that the individual changes to statements about behavior about statements (W_β). If the interest is to move from level 7 to level 3, then the individual not only need to switch from W_β to W_α, but also acquire K_β. This is considering the initial perception of the problem is kept.

This insight provides trainers and decision makers what they need to reduce the complexity of a problem for an individual. It may be cheaper or easier to send the individual to learn new knowledge, which is what traditionally is done. However, it may not be as simple to train for switching or acquiring new worldview. This also shows that in the ideal case where the number of statements of knowledge, worldview, and problem, can be quantified an individual may be able to predict the amount of effort it takes to understand a problem.

Engineering Managers are focused on improving the state of things, in this case, possibly improving understanding. However, the converse is also true; Engineering Managers may purposefully present problems to people where effort to understand is high. This could be of use in training, for instance, where the need to switch worldview or change the scope of problems could be of use in decision making activities. This is supported by the decision-making literature. It has been shown that problems under stress are possibly solvable when worldview is switched. From the proposed definitions, a switch in worldview undoubtedly leads to changes on problem and knowledge formulation. All these aspects prompt to consider besides training for acquisition of knowledge and worldview, to consider strategies for worldview creation and worldview switching

5.4 ON UNDERSTANDING AND CONCURRENT PROCESSES

Understanding is an integral part of concurrent cognitive processes. This explains why, in the literature, understanding is convoluted with some of these processes. The GTU provides a way to differentiate the process of understanding from these processes.

The first process with which understanding is embedded is that of perception. Perception posits how an individual senses her/his surroundings. Worldview for instance is considered in the body of knowledge as a form of perception. However, worldview, from the literature as well, is also about describing reality. Perception in this case is affected or steered by worldview in terms of predispositions or predominant worldview. An individual may choose to deal with one type of problem over another because s/he is predisposed to see the one s/he is predisposed to. This is explained by Bozkurt et al. (2007) and Bozkurt (2009). Through perception, an individual has access to reality and to this extent, it is used for decision making and/or learning. Decision making in this case could be a reactive process based on perception. In terms of learning, perception provides access to knowledge. In terms of understanding, perception provides, at the very least, access to problems.

Understanding is also associated with problem solving, decision making, and learning. Seeing problem solving as the execution of a solution and decision making as the evaluation of solutions, a solution is either a possible output of or input to the process of understanding. In the former, understanding assigns truth value to problems in order to generate a solution. In the latter, the solution is the problem whose truth values need to be evaluated. This explains Rittel and Webber's (1973) statement of "the information needed to understand the problem depends on one's idea for solving it." This says that a solution is a problem that needs to be understood.

Seeing learning as the acquisition of knowledge, understanding is then the use of knowledge. Therefore, knowledge must have been learnt to understand. In addition, understanding generates knowledge that may or may not be learned.

In connecting the processes of perception, learning, decision making, problem solving, and understanding, Sterman (1994) presents a description of this connective process as learning:

> *All learning depends on feedback. We make decisions that alter the real world; we receive information feedback about the real world, and using the new information we revise our understanding of the world and the decisions we make to bring the state closer to out goals.*

However, in Sterman's description there is a description of each one of the mentioned processes. Using Sterman's description as a baseline and based on working definitions, the connective process can be presented as: learning depends on feedback from the enactment of our understanding in the form of solutions. These solutions alter the real world; we observe these changes and using these changes as new knowledge and problems we revise what we had understood of the world. This revision of understanding results in the revision of our solutions which brings us closer to our goals. This description uses the definitions of knowledge and problem only.

In this process:

- Understanding generates knowledge (of solutions).
- This knowledge is enacted in decision making.
- Reality is altered due to decision making.

- Changes in reality are observed.
- From these changes knowledge and problems are learned.
- New knowledge and newly found problems are used to revise understanding.

From this process, not only do we acquire knowledge through learning but also problems and worldview. Individuals can learn about the existence of problems through feedback, perception, or by being told about them. These problems may or may not affect the individuals. If individuals are affected by these problems, then they may decide to understand them and/or take action on them. Individuals can learn worldview by cultural, political, educational, or religious influences among others. This process can be further expanded. For instance, the individual learns about problems through feedback, perception, or simply being told about them. Problems can also be generated by the process of understanding when it is being revised. In this case, something that was considered knowledge can now be re-evaluated and it can be decided that the assigned truth value is neither true nor false. Then knowledge becomes a problem.

Process-wise, this connective process can be seen as: through sensation/intuition (perception) new knowledge, problem, and worldview are acquired (learning); knowledge, problem, and worldview are matched (understanding), action or reaction (decision making/problem solving) is taken based on perception, learning, or understanding. Object-wise, through sensing/intuition knowledge, worldview, and problem are perceived and learnt. Understanding uses learnt knowledge, worldview, and problem and generates knowledge, worldview, and problem. The knowledge and worldview generated are used to solve problems or make decisions. Worldview is also used to reshape perception. Object-wise, this process represents an autopoietic process when it generates the elements needed to make the process work, in this case, its own input.

Understanding is at the heart of this autopoietic process by being autopoietic itself; understanding generates knowledge, worldview, and problem. It generates knowledge and feeds on it to yet create new knowledge. It generates worldview and feeds on it through its own explanations about the world to create new explanations. Finally, it generates problems when re-evaluating knowledge and feeds on them to generate new ones. In this case each knowledge, worldview, and problem may create knowledge, worldview and problem. However, this is a pure rationalist argument where the process feeds itself. Given that individuals deal with reality, this is not the general case. This is a reason why understanding needs the other processes; to make decisions and learn in order to revise what was understood. The interaction with the environment is needed to maintain the autopoietic process running.

5.5 ON AGENT-BASED MODELING AND SIMULATION

The implications on ABM are twofold: one methodologically corresponding to M&S and the second corresponding to the design of agents. In terms of methodology, this work uses agents for theory building. Traditionally, agents are used to build theory out of the identification of single rules from observations of the phenomenon of interest. These rules create emergent patterns that give rise to the new theory. In this work, the phenomenon is not observed. Single rules about the phenomenon are obtained from existing theories instead. Like the traditional case, emergence is observed and used to build new theory. Further, while simulation provides emergence, modeling provides a traceable axiomatic structure that formalizes the theory building process.

This methodological approach provides researchers with new ways of exploring little understood phenomena, especially where little theoretical consensus exists. This is of special interest to EM given the soft nature of many topics encountered within the discipline. In this case, it opens the possibility to formalize soft topics that are usually conveyed through argumentative means. In other words, it provides an objective means for discussing soft topics.

In terms of the design of agents, according to Tolk and Uhrmacher (2009), understanding is at the core of an agent in the form of sense making. Further, they relate sense making to processes such as perception and decision making within an agent. This relation similarly describes the autopoietic process suggested in the previous section. Tolk and Uhrmacher (2009) present an architectural framework addressing the main agents' characteristics. This framework was covered in section 3. The autopoietic process could contribute to the framework by considering:

- Worldview affecting perception through predispositions.
- Memory storing learnt knowledge, worldview, and problem from the environment.
- Decision making and problem solving considered as one process called action generation.
- Perception, learning, and understanding affecting action generation.
- Adaptation being removed as it could be considered a function of perception, learning, understanding, and action generation.
- Understanding taking the place of sense making and affecting and being affected by perception, learning, and action generation.

5.6 SUMMARY OF DERIVED THEORETICAL IMPLICATIONS

This section presented the main contributions to and implications of the GTU on the topic of understanding and on areas of interest to Engineering Management (EM).

In terms of understanding, the GTU allows for defining related concepts such as those of misunderstanding, lack of understanding, and inability to understand. Additionally, understanding is presented as a knowledge and worldview creation process. This has a direct implication on Knowledge Management (KM). KM is of importance to organizations as they become more knowledge centric and knowledge is considered an asset. The contribution of the GTU to EM is covered in areas such as complexity and decision making among others. In complexity, for instance, through insight drawn from the analysis of data it is shown that different people, within a problem situation, converge to seven levels of effort to understand. Effort to understand can be seen as a metric of how complex a problem is to a person. It is also shown that understanding is crucial to processes such as learning and decision making.

6 CONCLUSIONS AND FUTURE WORK

In conclusion, a review of the literature showed that a general case of understanding has not been established. To provide a solution, this dissertation presented a theory that explains the concept of understanding. The proposed general theory of understanding (GTU) explains what understanding is, what it does, how it does what it does, and why. The theory is consistent with accounts from epistemologists, cognitive science, education, and AI researchers. Additionally, it establishes new insights on understanding and on areas of interest to Engineering Management. The GTU defines understanding and provides outcomes of understanding. The outcomes of understanding are assignment of truth values to problems, generation of knowledge and generation of worldview. Given a new set of definitions, the GTU eliminates ambiguity found in the body of knowledge where descriptions of the concept are prevalent. Further, a disassociation from the widely used definition of understanding as 'grasping' is emphasized.

The GTU provides three schools of thought regarding understanding. KP-W reflects a person understanding a problem through knowledge application. In this case, a person applies her/his knowledge to a problem assuming that this application can be explained. This explanation amounts to a formulation of a solution. KW-P reflects a person understanding a problem through knowledge formulation. In this case, the person seeks to formulate, via worldview, her/his knowledge. This formulation will allow her/him to understand the problem at hand. Finally, (WP-K) reflects a person understanding a problem through the formulation of the problem. In this case, the person seeks to formulate, via worldview, the problem at hand. Two of these schools of thought, KP-W and KW-P, are found in the body of knowledge. KP-W is espoused by epistemologists, cognitive scientist and educational researchers. KW-P is espoused by AI researchers. WP-K is not found in the body of knowledge making it one of the main findings of this work. Through the GTU it is made clear and explicit that what was considered understanding is not one understanding, but three.

The GTU suggests metrics to subjectively assess understanding, one of them is effort to understand. Effort to understand is simply a counter that updates every time a person says s/he does not understand. As soon as the counter stops, it is a reflection of the person having understood the problem completely. Through the use of effort to understand it is shown that different understandings from different individuals converge to only seven levels of effort. These levels emerged from different initial conditions reflecting different individuals or different initial states within one individual. Levels 1 through 4 reflect low effort to understand by an individual, levels 5 and 6 reflect a moderately high effort to understand compared to levels 1 through 4, and level 7 shows an extremely high effort to understand compared to previous levels. The GTU drew from this emergent outcome to generalize that the higher the effort the more complex the person considers the problem. The consideration of different understandings and different levels of effort is consistent with problem situations. From these seven levels, the GTU shows that accepted ideas, such as more elements imply more complexity are not the general case. It is shown that there are levels where there are large numbers of defined problems, yet the problems are understood with less effort. Moreover, the idea that more knowledge implies more understanding is shown not to be the case. It is shown that it is more about the balance and alignment of the number of different types of statements than about the number of statements.

The GTU provides further insight into problem situations by considering the implications of shared understanding. It is shown that shared understanding is not only difficult but also not necessarily beneficial. Achieving shared understanding does not only need respective matching of knowledge, worldview, and problem to occur, but also "the matching of the matching" of different understanding among individuals need to occur. Unlike shared understanding, lack of shared understanding may be beneficial to decision making. In the hypothetical case when people share understanding it is implied that they share worldview as well. It is known that different perspectives are beneficial to group decision making. Ergo, lack of shared understanding should also be beneficial.

The GTU provides ways to differentiate perception, learning, decision making, and problem solving from understanding by seeing the connection of these processes as an autopoietic system. This system allows an individual to use and generate knowledge, worldview, and problem and through input-output of these parameters differentiate these processes from understanding, The GTU suggests that through sensing/intuition the person perceives reality and learns about knowledge, worldview, and problem. Understanding uses learnt knowledge, worldview, and problem and generates knowledge and worldview. Knowledge and worldview generated are used to act on problems, via problem solving or decision making, or simply learn. The enacted action changes reality generating knowledge and problem. With these changes learning occurs and understanding is revised. The revision of understanding, due to feedback, may change existing or new knowledge into a problem. This makes understanding a problem creation process. Finally, perception is constantly reshaped by understanding creating and revising worldview.

Through the presented autopoietic process, the GTU provides insight into designing agents as highlighting main processes and the inputs and outputs of these processes. This suggests the development of possible alternatives of an agent's architecture design. Further, the characterization of understanding, presented by the GTU can be used in existing architecture of agents that have perception, learning and decision making capabilities.

Lastly, the GTU provides a structured way to create theory out of theory using M&S, especially through the use of agents. This approach provides researchers with new ways of exploring poorly understood and complex phenomena opening the possibility to formalize soft topics that are usually conveyed through argumentative means.

Future work in or using the concept of understanding within EM presents different options. Some of the suggested research questions, from short to long term, are:

- *How can the Understanding Construct be used to improve decision making?* Given that EM's areas of interest rest on the ability to make decisions, this question would seek insight into the details of how understanding affects decision making and how it can be used to make better decisions. This question also extends to defining the conditions needed to make decisions when full understanding is not feasible within an allocated amount of time.
- *Under what conditions is shared understanding good for group decision making?* This question would seek insight into what conditions shared understanding is favorable and not favorable with regards to decision making and when those conditions should and should not be in place. It is hypothesized that shared understanding diminishes the effectiveness of decision making. Lack of shared understanding is hypothesized to be more beneficial to decision making given that it considers alternatives prompted by different understanding.
- *How does training need to be conducted to maximize understanding not only in terms of knowledge but also in terms of worldview?* This question seeks insight into how trainers can maximize trainees' ability to make decisions under different conditions based on prompt knowledge evaluation and possibly worldview adjustment.
- *Does exposing trainees to conditions of high effort foster adaptation? If not, what fosters adaptation of knowledge and worldview?* This is a follow up question to the previous bullet. This question seeks insight into how trainers can foster trainees' ability to adapt under different conditions. It is hypothesized that trainees trained under repeated high effort conditions will be able to switch worldview, for instance, when required. This is important for decision making given that if switching of worldview is considered, an individual may consider options obviated before.

Some of these questions can be approached through M&S, as done in this work or through experimentation depending on the access to data and ways of measuring observed constructs. In addition, some of these questions may be of interest to other disciplines such as Cognitive Science or M&S making them truly multidisciplinary if done in conjunction with engineering managers.

Finally, the reason why future work is presented as research questions stems from the author's belief that any research endeavor ought to generate more questions than it started with. This provides growth potential for the body of knowledge in a particular discipline and material for future generations of researchers. Further, new questions should provide grounds for theoretical and empirical research advancement. In other words, a path for future theoretical development and hypothesis testing should be laid down. These reflections make future work indeed part of the contribution of any research to the body of knowledge.

REFERENCES

Abrahamson, D., & Wilensky, U. (2005). Piaget? Vygotsky? I'm game!: Agent-based modeling for psychology research. *Paper presented at the annual meeting of the Jean Piaget Society, Vancouver, Canada.*

Ackoff, R. (1974). The systems revolution. *Long Range Planning* 7, 2-20.

Aerts, D., Apostel, L., De Moor, B., Hellemans, S., Maex, E., Van Belle, H., & Van der Veken, J. (1994). World Views: From Fragmentation to Integration. Brussels: VUB Press.

Alberts, D. & Hayes, R. (1995). *Command Arrangements for Peace Operations*. Washington D.C: CCRP Publication Series.

Albiero, F., Fitzek, F., & Katz, M. (2007). Introduction to NetLogo. In F. Fitzek & M. Katz (Eds.) *Cognitive Wireless Networks* (p. 579-602). The Netherlands: Springer.

Allee, V. (1997). *The knowledge evolution: Expanding organizational intelligence*. Boston, MA: Buttenworth-Heinemann.

Anderson, J. (1995). ACT – A simple theory of complex cognition. *American Psychologist,* 51(4), 355-365.

Axelrod, R. (1997). *The complexity of cooperation*. Princeton, NJ.: Princeton University Press.

Axtell, R. L. (2000). Why agents? On the varied motivations for agent computing in the social sciences. In C. Macal and D. Sallach (Eds.), *Proceedings of the Workshop on Agent Simulation: Applications, Models, and Tools*. Argonne, IL: Argonne National Laboratory.

Bahill, T. & Daniels, J, (2002). Using object-oriented & UML tools for hardware design: A case study. Systems Engineering, 6(1), p. 28-48.

Borshchev, A. & Filippov, A. (2004). From system dynamics and discrete event to practical agent based modeling: Reasons, techniques, tools. *Proceedings from the 22nd International Conference of the System Dynamics Society, July 25 - 29, Oxford, England.*

Bozkurt, I. (2009). Developing a philosophical profile of the individual for complex problem-solving through agent-based modeling. Dissertation, Old Dominion University, Norfolk, VA.

Bozkurt, I., Padilla, J.J., & Sousa-Poza, A. (2007). Philosophical profile of the individual, In *Proceedings from the 19th IEEE International Engineering Management Conference (IEMC)*, Austin, TX. July 29 - August 1.

Dake, K. (1991). Orienting dispositions in the perception of risk: An analysis of contemporary worldviews and cultural biases. *Journal of Cross-Cultural Psychology*, 22, 61-82.

DAU (2001). *Systems engineering fundamentals.* Fort Belvoir, VA: Defense Acquisition University Press.

Davis, J., Eisenhardt, K., and Bingham, C. (2007). Developing theory through simulation methods. *Academy of Management Review*, 32(2), 480-499.

Davis, P. & Anderson, R. (2003). *Improving the composability of department of defense models and simulations*. RAND Corporation: Santa Monica, CA.

De Regt, H. & Dieks, D. (2005). A contextual approach to scientific understanding. *Synthese,* 144, 137-170.

Diallo S., Tolk A. & Weisel E. (2007). Simulation formalisms: Review and comparison of existing definitions of key terms. *Fall Simulation Interoperability Workshop.* Orlando: IEEE CS Press.

El-Dirabi, T.E. & Wang, B. (2005). E-Society Portal: Integrating urban highway construction projects into knowledge city. *Journal of Construction Engineering and Management* DOI: 10.1061, 1196-1211.

Fisher, R. (1960). *The design of experiments*. (7th ed.) New York, NY: Georges, G., L.

Flood, R. & Carson, E. (1993). *Dealing with complexity: An introduction to the theory and application of systems science*. New York, NY: Plenum Press.

Ford, D. & Sterman, J. (1997). Expert knowledge elicitation to improve mental and formal models. *System Dynamics Review*, 14(4), 309-340.

Franklin, R.L. (1981). Knowledge, belief and understanding. *The Philosophical Quarterly*, 31(124), 193-208.

Gilbert, N. & Troitzsch, K. (2005). *Simulation for the social scientist*. New York, NY: Open University Press.

Gilbert, N. (2000). Models, Processes and Algorithms: Towards a Simulation Toolkit. In R. Suleiman, K. Troitzsch, and N. Gilbert. (Eds.). *Tools and techniques for social science* (pp. 3-16). Heidelberg: Physica-Verlag.

Gilbert, N. (2008). *Agent-based models*. Thousand Oaks, CA: SAGE Publications.

Grimm S.R. (2006) Is understanding a species of knowledge? *British Journal for the Philosophy of Science*. 57, 515-535.

Hester, P. & Tolk, A. (2010). Applying methods of the M&S spectrum for complex systems engineering. *Proceedings from the Spring Simulation Conference*. Orlando, Fl. April 11-15.

Hubler, A. (2005). Predicting complex systems with a holistic approach. *Complexity*, 10(3), 11-16.

INCOSE (2007). *Systems Engineering Handbook* version 3.1.

Jackson, M.C. & Keys, P. (1984). Towards a system of systems methodology. *The Journal of the Operations Research Society*, 35(6), 473-486.

Jennings (1999). Agent-based computing: promise and perils. *Proceedings of the 16th international joint conference on Artificial intelligence*, pp. 1429-1436, Stockholm, Sweden.

Jung, C.G. (1968). *Analytical psychology*. Retrieved from the web on January 15, 2009 http://www.psych.utoronto.ca/users/peterson/PSY2302007/Jung.pdf.

Keating, C. (2008). Paradoxes in the engineering of complex system of systems. *Proceedings from the 29th American Society for Engineering Management National Conferenc.* West Point, NY. November 12-15.

Keating, C., Padilla, J.J., & Adams, K. (2008). System of systems engineering requirements: Challenges and guidelines. *Engineering Management Journal*, 20(4), 24-31.

Kelton, W.D., Sadowski, R., & Sturrock, D. (2004). *Simulation with arena.* 3rd edition. New York, NY: McGraw-Hill.

Klahr, D. (1974). Understanding Understanding Systems. In L. W. Gregg (Ed.), *Knowledge and Cognition*, (pp. 295-300). Potomac, MD: Lawrence Erlbaum Associates.

Klein, G. (1998). *Sources of power*. Cambridge, MA: MIT Press.

Klir, G. (1985). Complexity: Some general observations. *Systems Research,* 2(2), 131-140.

Koltko-Rivera, M.E. (2004). The psychology of worldviews. *Review of General Psychology,* 8(10), 3-58.

Kotnour, T. & Farr, J. (2005). Engineering management: Past, present and future, *Engineering Management Journal,* 17(1),15-27.

Kuhn, D., & Reilly, M. (2002). An investigation of the applicability of design of experiments to software testing. *Proceedings of the 27 the Annual NASA/IEEE Software Engineering Workshop*. NASA Goddard Space Flight Center. December 4-6.

Lannes, W.,J. (2001). What is engineering management? *IEEE Transactions on Engineering Management,* 48(1), 107–115.

Leonard, N., Scholl, R., & Kowalski, K. (1999). Information processing style and decision making. *Journal of Organizational Behavior*, 20(3), pp. 407-420

Mayer, R. (1989). Models for understanding. *Review of Educational Research,* 59(1), 43-64.

Mitroff, I., Betz, F., Pondy, L.R. & Sagasti, F. (1974). On managing science in the systems age: Two schemes for the study of science as a whole systems phenomenon. *Interfaces*, 4(3), 46-58.

Miyake, N. (1986). Constructive interaction and the iterative process of understanding. *Cognitive Science*, 10, 151-177.

Moore, J. & Newell, A. (1974). How can Merlin understand. In L. W. Gregg (Ed.) *Knowledge and Cognition* (pp. 201-252). Potomac, MD: Lawrence Erlbaum Associates.

Nair, K. U., & Ramnarayan, S. (2000). Individual differences in need for cognition and Complex Problem Solving. *Journal of Research in Personality, 34*, 305-328.

Negnevitsky, M. (2005). *Artificial Intelligence: A guide to intelligent systems*. Harlow, England: Addison-Wesley.

Nickerson, R. (1985). Understanding understanding. *American Journal of Education*, 93(2), 201-239.

Nonaka, I. & Takeuchi, N. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. New York, NY: Oxford University Press.

Nonaka, I., Konno, N., & Toyama R. (2001), Emergence of "Ba": A conceptual framework for the continuous and self-transcending process of knowledge creation. In I. Nonaka and T. Nishiguchi (Eds.) *Knowledge emergence* (pp. 13-29). New York, NY: Oxford University Press.

Ogren, I. (1999). On principles of Model-Based Systems Engineering. *Systems Engineering*, 3(1), p. 38-94.

Ören, T., Ghassem-Aghaee, N., & Yilmaz, L. (2007). An ontology-based dictionary of understanding as a basis for software agents with understanding abilities. *Proceedings of the 2007 Spring Simulation Multiconference*, Norfolk, VA. March 25-29.

Pears, D.F. (1971). *What is knowledge?* New York, NY: Harper & Row.

Perkins, D.N., (1988). Art as understanding. *Journal of Aesthetic Education.* Special Issue: Art, Mind, and Education, 22(1), 111-131.

Plato (1999), Theaetetus, Project Guttenberg, Translation by Benjamin Jowett. Retrieved from the web on June 2006. http://www.gutenberg.org/dirs/etext99/thtus10.txt

Reiner, G (2005). Supply chain management research methodology using quantitative models based on empirical data. In H. Kotzab, S. Seuring, M. Muller, &. Reiner (Eds.), *Research Methodologies in Supply Chain Management* (pp. 432-444). The Netherlands: Physica Verlag.

Rescher, N. (1996). *Process metaphysics: An introduction to process philosophy.* Albany, NY: State University of New York Press.

Rittel, H. & Webber, M. (1973), Dilemmas in a General Theory of Planning, *Policy Sciences*, 4, 155-169.

Rowley, J. (2000). From learning organization to knowledge entrepreneur. *Journal of Knowledge Management*, 4(1), 7-15.

Russell S. & Norvig P. (2003). *Artificial Intelligence: A Modern Approach*. Upper Saddle River, New Jersey: Prentice Hall.

Ryle, G. (1949). *The Concept of mind*, Chicago, IL: University of Chicago Press.

Sage, A. (1992). *Systems Engineering*. New York, NY: Wiley.

Sousa-Poza, A., Padilla, J.J., & Bozkurt, I. (2008). Implications of a rationalist inductive approach in system of systems engineering research. In Proceedings of IEEE International Conference on System of Systems Engineering, Systems, Man, and Cybernetics. doi: 10.1109/SYSOSE.2008.4724186

Sterman, J. (1994). Learning in and about complex systems. *System Dynamics Review*. 10(2-3), 291-330.

Sternberg, R. J., Wagner, R., Williams, W., & Horvath, J. (1995). Testing common sense. *American Psychologist*, 50(11), 912-927.

Tallman, I., Leik, R. K., Gray, L. N. & Stafford, M. C. (1993). A theory of problem-solving behavior. *Social Psychology Quarterly, 56*(3), 157-177.

Tolk, A. & Uhrmacher, A. (2009). Agents: Agenthood, agent architectures, and agent taxonomies. In L. Yilmaz and T. Ören (Eds.) *Agent-Directed Simulation & Systems Engineering* (p. 87-126). New York, NY: John Wiley & Sons

Understanding (2009). In *Dictionary.com*. Retrieved June 27, 2009, from http://dictionary.reference.com/browse/understanding.

Understanding (2009). In *Merriam-Webster Online Dictionary*. Retrieved June 27, from http://www.merriam-webster.com/dictionary/understanding.

Vennix, J. (1996). *Group Model Building*. New York, NY: Wiley.

Zagzebski, L. (2001). Recovering Understanding. In M. Steup (Ed.), *Knowledge, Truth, and Duty: Essays on Epistemic Justification, Responsibility, and Virtue*. New York, NY: Oxford University Press.

APPENDICES

A. DESIGN OF EXPERIMENTS – FULL FACTORIAL, 7 FACTORS AT 2 LEVELS (2^7)

Condition\Factor	K-alfa	K-Beta	W-Alfa	W-Beta	P-Alfa	P-Beta	WO	C\F	K-alfa	K-Beta	W-Alfa	W-Beta	P-Alfa	P-Beta	WO	C\F	K-alfa	K-Beta	W-Alfa	W-Beta	P-Alfa	P-Beta	WO	C\F	K-alfa	K-Beta	W-Alfa	W-Beta	P-Alfa	P-Beta	WO
1	L	L	L	L	L	L	L	33	L	L	L	L	L	L	H	65	L	H	L	L	L	L	L	97	L	H	L	L	L	L	H
2	L	L	L	L	L	H	L	34	L	L	L	L	L	H	H	66	L	H	L	L	L	H	L	98	L	H	L	L	L	H	H
3	H	L	L	L	L	L	L	35	H	L	L	L	L	L	H	67	H	H	L	L	L	L	L	99	H	H	L	L	L	L	H
4	H	L	L	L	L	H	L	36	H	L	L	L	L	H	H	68	H	H	L	L	L	H	L	100	H	H	L	L	L	H	H
5	L	L	H	L	L	L	L	37	L	L	H	L	L	L	H	69	L	H	H	L	L	L	L	101	L	H	H	L	L	L	H
6	L	L	H	L	L	H	L	38	L	L	H	L	L	H	H	70	L	H	H	L	L	H	L	102	L	H	H	L	L	H	H
7	H	L	H	L	L	L	L	39	H	L	H	L	L	L	H	71	H	H	H	L	L	L	L	103	H	H	H	L	L	L	H
8	H	L	H	L	L	H	L	40	H	L	H	L	L	H	H	72	H	H	H	L	L	H	L	104	H	H	H	L	L	H	H
9	L	L	L	H	L	L	L	41	L	L	L	H	L	L	H	73	L	H	L	H	L	L	L	105	L	H	L	H	L	L	H
10	L	L	L	H	L	H	L	42	L	L	L	H	L	H	H	74	L	H	L	H	L	H	L	106	L	H	L	H	L	H	H
11	H	L	L	H	L	L	L	43	H	L	L	H	L	L	H	75	H	H	L	H	L	L	L	107	H	H	L	H	L	L	H
12	H	L	L	H	L	H	L	44	H	L	L	H	L	H	H	76	H	H	L	H	L	H	L	108	H	H	L	H	L	H	H
13	L	L	H	H	L	L	L	45	L	L	H	H	L	L	H	77	L	H	H	H	L	L	L	109	L	H	H	H	L	L	H
14	L	L	H	H	L	H	L	46	L	L	H	H	L	H	H	78	L	H	H	H	L	H	L	110	L	H	H	H	L	H	H
15	H	L	H	H	L	L	L	47	H	L	H	H	L	L	H	79	H	H	H	H	L	L	L	111	H	H	H	H	L	L	H
16	H	L	H	H	L	H	L	48	H	L	H	H	L	H	H	80	H	H	H	H	L	H	L	112	H	H	H	H	L	H	H
17	L	L	L	L	H	L	L	49	L	L	L	L	H	L	H	81	L	H	L	L	H	L	L	113	L	H	L	L	H	L	H
18	L	L	L	L	H	H	L	50	L	L	L	L	H	H	H	82	L	H	L	L	H	H	L	114	L	H	L	L	H	H	H
19	H	L	L	L	H	L	L	51	H	L	L	L	H	L	H	83	H	H	L	L	H	L	L	115	H	H	L	L	H	L	H
20	H	L	L	L	H	H	L	52	H	L	L	L	H	H	H	84	H	H	L	L	H	H	L	116	H	H	L	L	H	H	H
21	L	L	H	L	H	L	L	53	L	L	H	L	H	L	H	85	L	H	H	L	H	L	L	117	L	H	H	L	H	L	H
22	L	L	H	L	H	H	L	54	L	L	H	L	H	H	H	86	L	H	H	L	H	H	L	118	L	H	H	L	H	H	H
23	H	L	H	L	H	L	L	55	H	L	H	L	H	L	H	87	H	H	H	L	H	L	L	119	H	H	H	L	H	L	H
24	H	L	H	L	H	H	L	56	H	L	H	L	H	H	H	88	H	H	H	L	H	H	L	120	H	H	H	L	H	H	H
25	L	L	L	H	H	L	L	57	L	L	L	H	H	L	H	89	L	H	L	H	H	L	L	121	L	H	L	H	H	L	H
26	L	L	L	H	H	H	L	58	L	L	L	H	H	H	H	90	L	H	L	H	H	H	L	122	L	H	L	H	H	H	H
27	H	L	L	H	H	L	L	59	H	L	L	H	H	L	H	91	H	H	L	H	H	L	L	123	H	H	L	H	H	L	H
28	H	L	L	H	H	H	L	60	H	L	L	H	H	H	H	92	H	H	L	H	H	H	L	124	H	H	L	H	H	H	H
29	L	L	H	H	H	L	L	61	L	L	H	H	H	L	H	93	L	H	H	H	H	L	L	125	L	H	H	H	H	L	H
30	L	L	H	H	H	H	L	62	L	L	H	H	H	H	H	94	L	H	H	H	H	H	L	126	L	H	H	H	H	H	H
31	H	L	H	H	H	L	L	63	H	L	H	H	H	L	H	95	H	H	H	H	H	L	L	127	H	H	H	H	H	L	H
32	H	L	H	H	H	H	L	64	H	L	H	H	H	H	H	96	H	H	H	H	H	H	L	128	H	H	H	H	H	H	H

B. MEANS OF EFFORT FOR WP-K, KW-P, AND KP-W

Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W
1	28.852	29.056	29.204	33	30.848	30.056	30.5	65	196.712	188.5	204.996	97	192.864	195.54	182.688
2	301.544	302.976	297.028	34	297.564	298.876	299.768	66	288.64	285.192	285.8	98	299.416	297.116	290.68
3	196.252	184.624	178.756	35	199.016	190.92	191.968	67	28.088	29.88	28.984	99	26.756	29.408	31.064
4	3516.572	3550.764	3367.22	36	3543.672	3559.104	3517.356	68	281.888	300.224	285.072	100	278.808	298.208	297.976
5	176.48	184.172	191.748	37	185.964	200.98	200.344	69	188.04	194.24	190.756	101	193.088	193.148	196.18
6	3344.716	3562.944	3473.976	38	3510.804	3553.336	3509.776	70	1839.372	1957.076	1912.424	102	1921.964	1976.892	1937.42
7	1801.584	1875.696	1740.56	39	1849.656	1930.56	1748.732	71	174.5	199.336	186.052	103	192.632	196.592	188.848
8	33457.66	35915.01	33655.75	40	34888.4	35777.48	34597.27	72	3290.792	3611.58	3465.724	104	3413.776	3595.4	3501.272
9	191.336	185.46	192.248	41	191.02	184.824	192.784	73	1818.684	1924.596	1841.104	105	1878.528	2068.352	1813.736
10	292.708	295.256	286.592	42	293.624	293.9	298.44	74	1755.912	1927.952	1868.928	106	1864.248	2010.852	1811.276
11	189.044	196.372	191.88	43	190.708	198.94	188.72	75	172.552	196.628	203.056	107	189.036	201.936	181.056
12	1894.416	1952.096	1839.34	44	1898.436	1931.604	1929.948	76	267.908	296.008	285.836	108	273.348	309.948	288.276
13	30.136	30.416	29.812	45	29.156	30.52	29.04	77	195.576	204.712	195.356	109	199.156	200.152	175.972
14	284.76	304.204	281.976	46	291.768	305.168	281.036	78	282.704	301.528	271.376	110	289.332	310.24	268.456
15	177.352	200.176	177.572	47	183.748	202.576	185.92	79	26.728	29.524	29.016	111	27.936	29.22	26.88
16	3460.188	3672.764	3325.512	48	3493.496	3685.88	3380.916	80	279.2	294.804	272.64	112	281.616	294	279.464
17	299.34	304.164	301.036	49	300.304	299.616	303.868	81	3526.156	3597.772	3533.632	113	3574.028	3603.424	3645.316
18	585.856	588.556	585.816	50	580.288	584.252	576.58	82	3683.556	3656.112	3730.504	114	3652.348	3666.532	3735.272
19	289.1	288.504	269.84	51	294.464	287.988	284.708	83	279.548	305.848	302.136	115	279.224	303.504	297.672
20	3637.616	3675.24	3458.332	52	3634.484	3694.308	3623.396	84	538.02	589.968	572.532	116	536.16	588.128	560.564
21	278.276	290.512	288.72	53	291.728	284.856	289.524	85	1915.368	1989.832	1920.544	117	1906.68	1974.288	1913
22	3485.072	3686.56	3650.796	54	3635.62	3677.968	3610.488	86	3608.936	3794.228	3711.708	118	3649.508	3834.628	3678.132
23	1768.324	1935.76	1800.432	55	1852.956	1846.692	1755.36	87	273.2	294.076	277.652	119	267.324	297.924	282.484
24	33764.98	35406.43	34073.04	56	35050.92	36028.42	34678.32	88	3404.844	3747.668	3588.92	120	3472.388	3706.58	3645.224
25	3633.764	3593.012	3555.532	57	3608.264	3573.508	3538.732	89	34899.75	36588.97	35439.27	121	34776.36	36471.1	35563.83
26	3683.556	3686.544	3636.036	58	3747.184	3724.308	3657.404	90	35351.11	36589.35	35207.36	122	34981.24	36500.23	35346.17
27	1925.316	1976.764	1949.316	59	1941.696	1978.84	1926.344	91	3427.32	3750.972	3587.68	123	3439.272	3756.688	3523.244
28	3707.032	3795.116	3608.124	60	3671.648	3789.292	3639.192	92	3555.084	3909.116	3723.396	124	3470.592	3909.844	3666.14
29	307.596	303.472	280.512	61	296.004	301.656	285.092	93	3640.988	3711.02	3458.228	125	3559.212	3714.028	3424.384
30	575.084	591.268	542.856	62	568.548	585.02	531.832	94	3765.204	3848.268	3548.912	126	3661.368	3814.092	3512.048
31	288.972	296.852	266.3	63	279.984	298.624	272.632	95	280.564	297.288	278.252	127	275.088	297.12	277.228
32	3569.804	3779.264	3420.696	64	3609.728	3792.14	3487.548	96	531.572	581.168	533.224	128	526.412	584.516	521.548

C. MEANS OF TIME FOR WP-K, KW-P, AND KP-W

Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W
1	21676.98	1990.784	23241.95	33	3327.96	2084.176	3287.036	65	21907.74	9130.264	26722.66	97	9796.552	9584.388	9761.756
2	42584.56	7422.224	41481.48	34	8706.368	7337.548	8735.544	66	21479.44	8996.912	24389.97	98	10905.25	9538.768	10386.26
3	21072.25	8855.184	23530.63	35	10221.7	8700.4	10389.66	67	1780.852	1187.912	2244.08	99	1142.26	1190.392	1333.176
4	50012.23	24161.78	55911.22	36	25423.46	24359.89	23821.48	68	3259.936	2256.5	3955.592	100	2256.624	2206.172	2223.192
5	22628.61	8662.496	21140.08	37	10334.39	9628.56	10318.13	69	1927.88	742.296	1964.776	101	1199.264	740.368	1237.844
6	56430.4	24447.56	49638.35	38	24332.25	24152.02	24899.68	70	3558.4	1600.348	3673.604	102	2221.004	1627.436	2231.448
7	28581.19	10121.65	27053.84	39	17045.52	10697.4	16645.87	71	1691.512	914.044	1810.376	103	1391.988	952.824	1290.732
8	63304.59	30303.53	63936.4	40	40515.88	30253.58	39815.8	72	3857.268	2397.984	4235.124	104	3059.312	2350.024	2958.56
9	25744.78	8962.056	21281.18	41	10639.7	8878.852	9935.32	73	28655.26	10640.26	29079.71	105	17917.18	11270.64	17246.68
10	25046.94	9274.468	20727.72	42	10592.15	9528.764	10098.28	74	27409.34	10444.19	28618.28	106	17089.5	10697.41	16610.84
11	1954.368	733.5	1976.664	43	1223.244	782.052	1179.168	75	1643.056	939.916	2048.508	107	1331.888	934.88	1204.396
12	3558.5	1641.932	3486.952	44	2254.976	1620.26	2251.7	76	1698.312	968.284	1905.536	108	1311.696	1010.688	1290.088
13	2390.748	1238	1817.872	45	1220.532	1218.04	1223.196	77	1942.68	981.444	1903.072	109	1375.604	965.376	1239.316
14	3902.524	2318.9	3256.396	46	2216.072	2304.224	2288.144	78	1854.688	961.02	1676.44	110	1264.168	994.812	1253.708
15	1764.12	949.364	1695.072	47	1278.568	966.556	1383.528	79	136.608	79.944	149.992	111	111.4	79.092	108
16	4189.432	2415.704	3893.912	48	2920.456	2416.616	3077.868	80	262.572	152.464	258.664	112	198.96	151.832	196.98
17	43145.7	7491.552	43527.6	49	8818.016	7331.196	8880.996	81	50188.74	24608.86	58799.41	113	25547.75	24892.88	24981.06
18	50836.52	11715.18	51644.4	50	12993.02	11614.65	12887.21	82	53361.5	24531.88	61848.12	114	25250.38	24037.82	24778.94
19	21244.13	9349.492	22872.09	51	10025.93	9285.384	10190.91	83	3362.852	2307.712	4169.192	115	2287.716	2353.372	2218.576
20	49501.64	24996.26	56186.19	52	25613.88	24625.2	23773.12	84	3770.216	2760.176	4719.716	116	2701.312	2696.96	2546.816
21	24081.32	9448.376	20835.7	53	10637.53	9069.52	10031.4	85	3608.868	1655.568	3624.36	117	2212.94	1629.972	2218.868
22	55996.93	24100.31	50551.8	54	24472.9	24606.42	25357.59	86	4101.868	2059.364	4336.692	118	2554.072	2059.364	2569.492
23	27666.68	10519.22	27012.23	55	16810.43	9811.456	16323.93	87	1729.952	924.544	1862.892	119	1272.752	918.564	1299.636
24	64062.76	29454.8	63997.74	56	40128.52	29799.41	40507.3	88	3953.404	2329.852	4353.572	120	2973.884	2310.94	3066.964
25	60551.94	24830.13	49956.2	57	24581.97	24350.27	25572.75	89	66438.76	29713.51	66248.8	121	40152.94	30164.92	40583.91
26	59945.34	24596.86	50045.18	58	24649.11	24806.21	25640.21	90	66781.69	30280.29	65171.65	122	40438.16	30424.2	41756.66
27	3793.748	1627.228	3682.024	59	2265.32	1660.512	2282.548	91	3985.044	2480.3	4422.872	123	3088.944	2498.08	2987.42
28	4198.508	2073.648	4145.724	60	2601.552	2063	2570.244	92	4105.696	2498.828	4650.016	124	3108.832	2504.864	3064.724
29	4278.136	2314.72	3268.872	61	2290.756	2290.216	2330.552	93	4499.344	2401.028	4147.352	125	3070.456	2439.172	3071.424
30	4785.884	2759.024	3906.932	62	2551.352	2741.864	2704.88	94	4494.632	2441.212	4063.496	126	2937.368	2387.896	3058.38
31	1907.988	956.404	1613.552	63	1282.032	976.208	1288.92	95	261.42	152.328	259.904	127	201.008	151.332	199.088
32	4254.28	2381.12	3976.368	64	3073.552	2400.328	3054.556	96	292.716	185.788	289.76	128	225.164	187.5	224.512

D. DATA ANALYSIS

Level 2

The challenge for analysis that level 2 presents is that it contains more initial conditions. Whereas level 1 has 8 conditions, level 2 has 20 as it can be seen in Table 21.

Condition\Factor	K_α	K_β	W_α	W_β	P_α	P_β	WO
3	H	L	L	L	L	L	L
5	L	L	H	L	L	L	L
9	L	L	L	H	L	L	L
11	H	L	L	H	L	L	L
15	H	L	H	H	L	L	L
35	H	L	L	L	L	L	H
37	L	L	H	L	L	L	H
41	L	L	L	H	L	L	H
43	H	L	L	H	L	L	H
47	H	L	H	H	L	L	H
65	L	H	L	L	L	L	L
69	L	H	H	L	L	L	L
71	H	H	H	L	L	L	L
75	H	H	L	H	L	L	L
77	L	H	H	H	L	L	L
97	L	H	L	L	L	L	H
101	L	H	H	L	L	L	H
103	H	H	H	L	L	L	H
107	H	H	L	H	L	L	H
109	L	H	H	H	L	L	H

Table 21. Level 2 Initial Conditions

What can immediately be observed is that, unlike level 1, in level 2, knowledge and worldview are not uniform in terms of settings (both knowledge and worldview have both settings, high and low). On the other hand, what makes this level similar to level 1 is that problem is still at low setting in all conditions.

A Levene test was conducted for this level to establish homogeneity of variances for comparison purposes. However, according to the test, they variances are not homogeneous. A Tamhane's T2 test was then conducted in order to compare the different conditions. The results of this test are in Appendix G. A plot of means for effort is shown in Figure 39 and the result of the Levene test in Table 22.

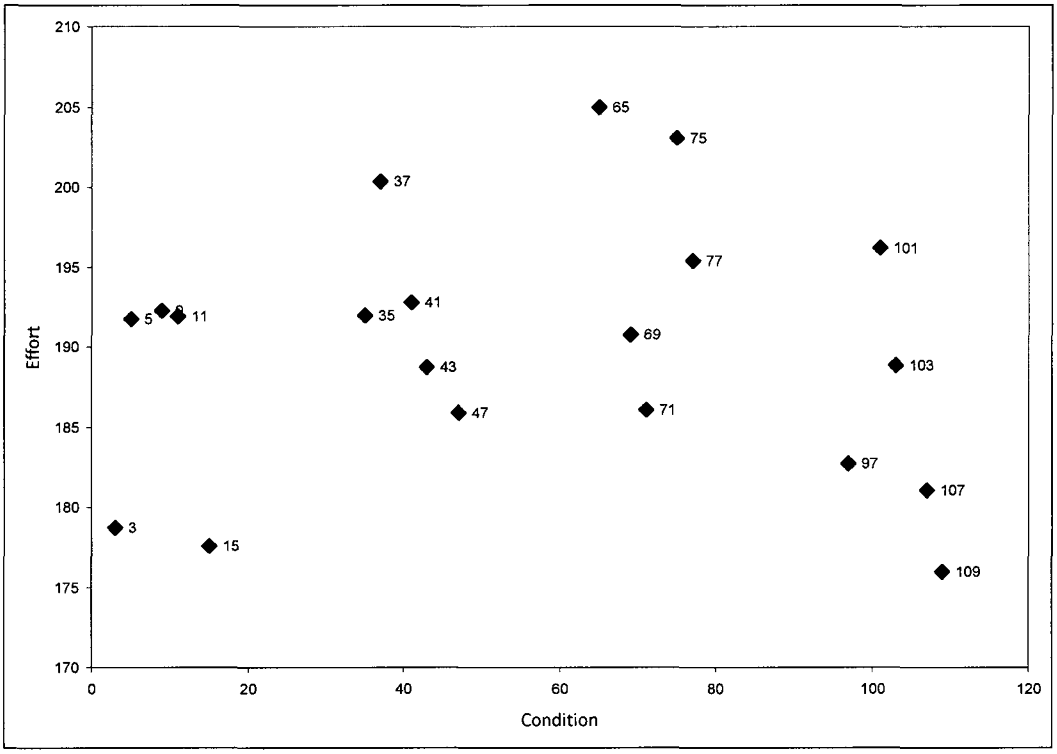

Figure 39. Plot of Means Level 2 (Effort)

Test of Homogeneity of Variances

Effort

Levene Statistic	df1	df2	Sig.
6.599	19	4980	.000

Table 22. Levene Test for Level 2 (Effort)

From the Tamhane's T2 test it can be observed that all initial conditions are equivalent with a few exceptions, namely, conditions 109 from 65, and 75 and 15 from 65. These conditions are not equivalent given that they are placed at extreme levels from one another (see Figure 39). Taking conditions 3, 15, and 109 out (extreme lows) and running the Tamhane's T2 test, the remaining conditions are statistically equivalent (results in Appendix H).

As was done for level one, given that there is not another significantly close level, they are considered within the same level for assessment. Although most conditions are statistically equivalent, it can be observed that there is more difference from condition to condition than at level 1, which is consistent with the observation that the higher up in the level, the more variability in between means.

From the assessment of level 1 it was concluded that a high knowledge setting is equivalent to high worldview setting. In this level, comparing conditions 3 and 5 and conditions 9 and 65, it can be concluded that having one type of knowledge high is equivalent to having the corresponding worldview type at a high setting. This implies that worldview is as important as knowledge when it comes to understanding and it should not be assumed or ignored.

Comparing conditions 9 and 75 it can be concluded that more knowledge does not imply better understanding at this level either, given that these two conditions are statistically equivalent.

Finally, WO is of no statistical impact at this level either. This is concluded after comparing conditions with same knowledge and/or worldview settings with low and high WO levels, namely, conditions 9 and 41, 5 and 37, 11 and 43, 71 and 103, 75 and 107, 77 and 109, and 65 and 97.

Now, as in level 1, in most conditions time is not normally distributed. For simplification purposes, non-parametric tests for all conditions are obviated. Instead, assessment is based on the data which is shown in Figure 40 and non-parametric tests run on the need to basis. Comparing Table 21 and Figure 40 shows that the conditions that take the most time are those that have a high setting on one type of knowledge or worldview (conditions 3, 5, 9, and 65) and WO is low. There is a mid level where the same setting takes place, but WO is high (35, 37, 43, and 97). Lastly, the conditions that take the least time are those that contain at least one type of knowledge and one type of worldview at high settings.

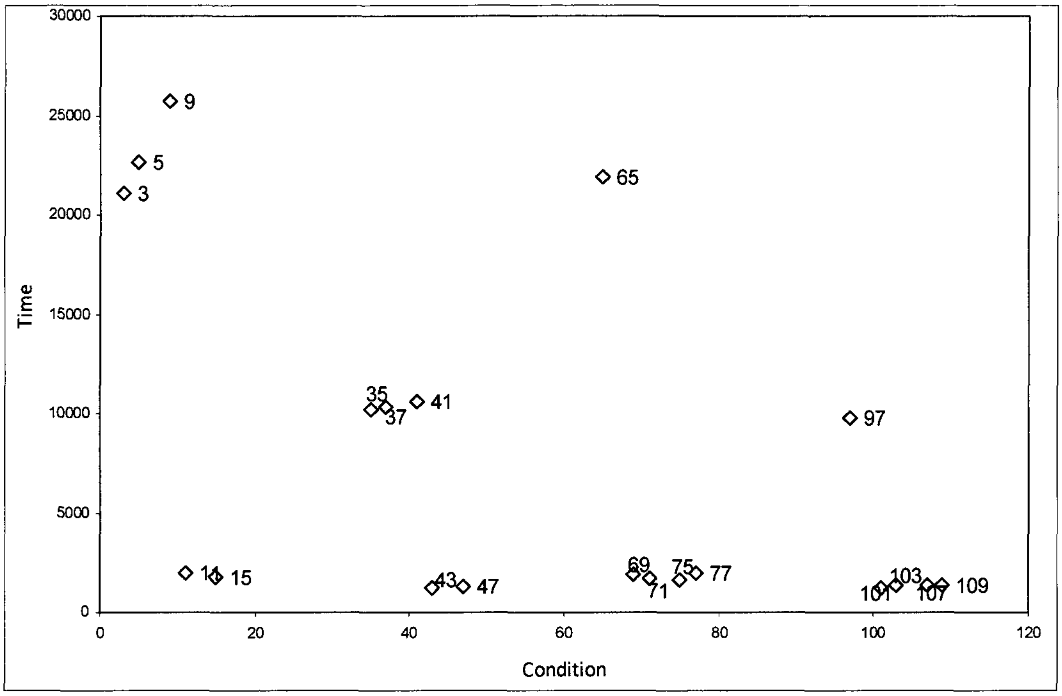

Figure 40. Plot of Means for Level 2 (Time)

Taking a closer look at conditions 71 and 103 that appear at the lower level and comparing them using a Mann-Whitney U Test (Table 23), it can be concluded that they are not statistically equivalent. This occurred regardless of their apparent proximity in term of means. Therefore, WO has an effect in terms of time at this level as well.

Test Statistics[a]

	VAR00001
Mann-Whitney U	20425.000
Wilcoxon W	51800.000
Z	-6.701
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: VAR00002

Table 23. Mann-Whitney U Test comparing Conditions 71 and 103 (Time)

It can be concluded that not only does WO have a positive effect, as it did in level 1, on understanding in terms of time but also a mix of knowledge and worldview setting.

Comparing condition 3 (level 2) with condition 1 (level 1), they are statistically equivalent. This means that more information (K_α equivalency) does not necessarily improve the time of understanding (Table 24) in KP-W.

Test Statistics[a]

	VAR00001
Mann-Whitney U	30334.000
Wilcoxon W	61709.000
Z	-.567
Asymp. Sig. (2-tailed)	.571

a. Grouping Variable: VAR00002

Table 24. Mann-Whitney U test comparing Conditions 1 and 3 (Time)

Similar cases are found when comparing conditions 15 and 101, 47 and 101, and 71 and 43 in KW-P. KW-P, unlike KP-W and WP-K does not depend on WO. In these cases it can be observed that higher settings do not mean faster times. This is shown in Table 25. The asymptotic significance when comparing conditions 15 and 71 < 0.05 what makes them not statistically equivalent. Further, Table 26 shows how condition 15, despite having higher settings, ranks higher (takes longer) in terms of time.

Test Statistics[a]

	Time
Mann-Whitney U	25245.000
Wilcoxon W	56620.000
Z	-3.717
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Type

Table 25. Mann-Whitney Test comparing Conditions 15 and 71 (Time)

Ranks

	Type	N	Mean Rank	Sum of Ranks
Time	1	250	274.52	68630.00
	2	250	226.48	56620.00
	Total	500		

Table 26. Mann-Whitney Test Rank Table comparing Conditions 15 and 71 (Time)

Now, the comparison of the three types of understanding in terms of effort and time for level 2 is going to be based on their overall behavior. As in level 1, this is due to some conditions that are not normally distributed, for effort, and most of the conditions for time. Figure 41 and Figure 42 show the comparison among the three types for effort and time respectively.

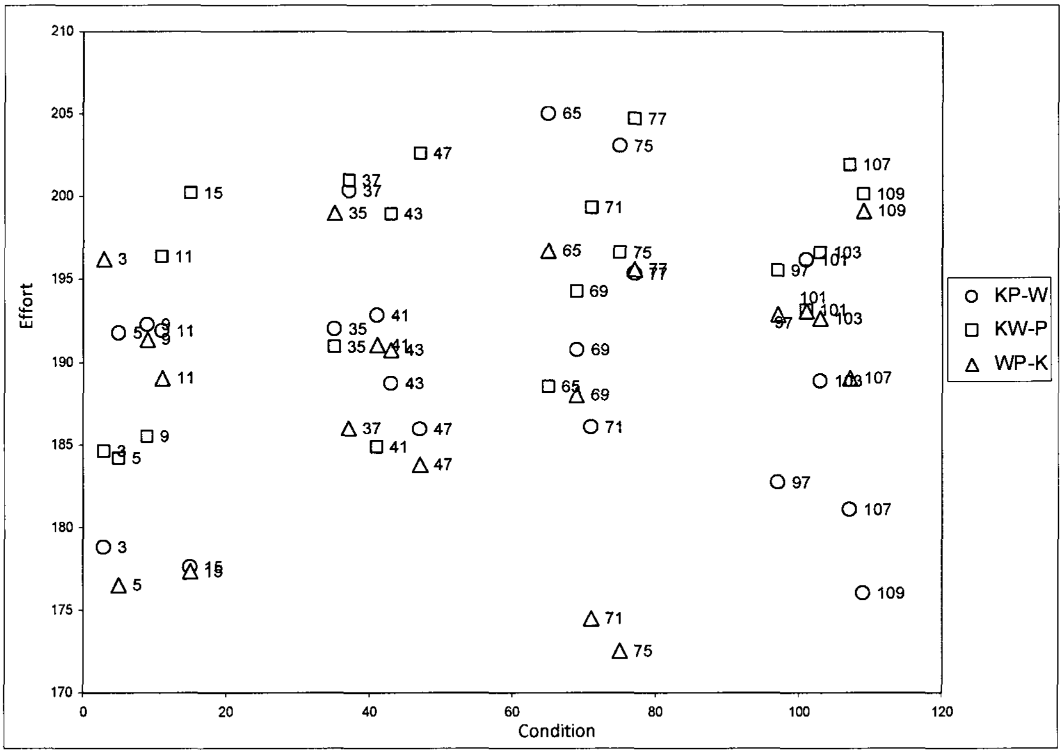

Figure 41. Comparison of Means for KP-W, KW-P, and WP-K at Level 2 (Effort)

As previously concluded for level 1, depending on the condition one type of understanding may perform better than the others in terms of effort and/or time. Unlike effort, the difference of means, in terms of time, is large. This says that even though conditions are equivalent in terms of effort, time needs to be considered if one were to obtain a way to make understanding more efficient. In terms of effort, there are 10 cases where KW-P apparently is worse than its counterparts. Of this 10 cases, 11, 15, 37, 43, 47, 71, 75, 77, 97, 107, and 109, half have high WO and the other half have low WO. Of the remaining 10, KP-W and WP-K apparently perform better under different settings, KP-W mostly when WO is high, WP-K when WO is low. It is said mostly, because there are some exceptions. This highlights what was said before; it is about the combination of settings of factors when looking for who presents better understanding out of the three types. For instance, for condition 65 KW-P takes (apparently) both less effort and less time to reach understanding. On the other hand, for condition 71, WP-K effort is less, while taking more time than its counterparts (apparently). On condition 109, KP-W takes less effort and more time than its counterparts.

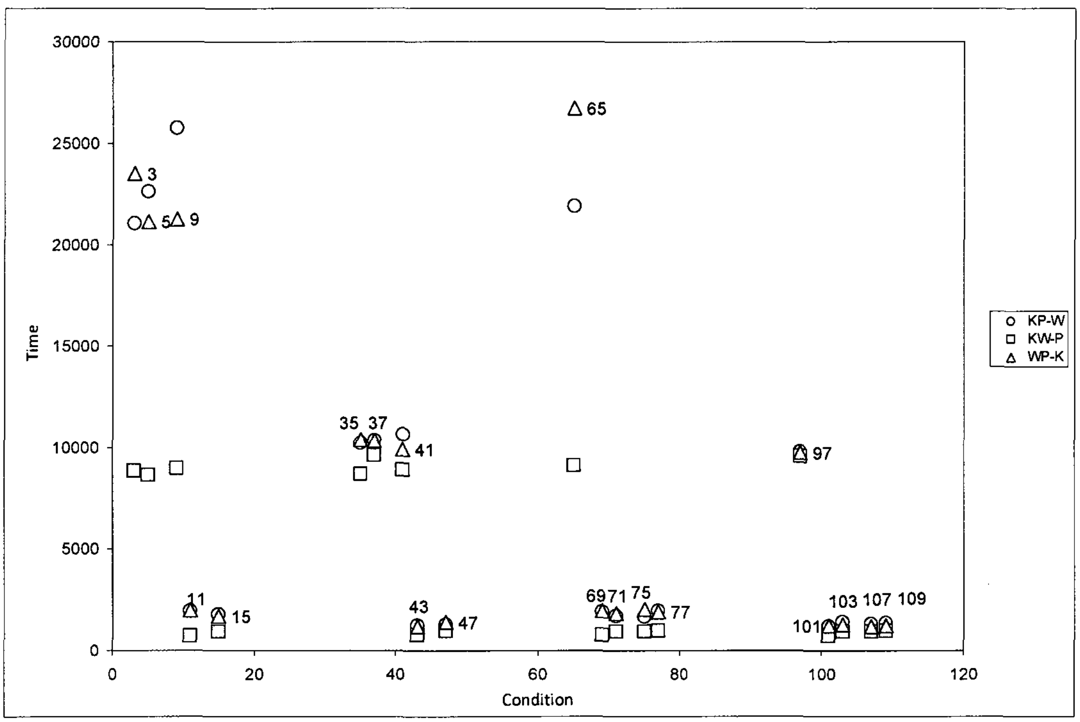

Figure 42. Comparison of Means for KP-W, KW-P, and WP-K at Level 2 (Time)

Conducting a Tukey HSD test, it can be concluded that the three types of understanding are statistically the same in condition 65 and KP-W statistically different in condition 109 (Tables 27 and 28 respectively). Tukey HSD test was used because conditions are normally distributed and variance are homogeneous.

Effort

Tukey HSD[a]

Type	N	Subset for alpha = .05
		1
2	250	188.5000
3	250	196.7120
1	250	204.9960
Sig.		.057

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 250.000.

Table 27. Tukey HSD Test Comparing Condition 65 (Effort)

Effort

Tukey HSD[a]

Type	N	Subset for alpha = .05	
		1	2
1.00	250	175.9720	
3.00	250		199.1560
2.00	250		200.1520
Sig.		1.000	.990

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 250.000.

Table 28. Tukey HSD Test Comparing Condition 109 (Effort)

Evaluating condition 109 in terms of time, a Kruskal-Wallis test shows that the three types of understanding are not statistically equivalent even though, they appear closer in terms of means. It can be extrapolated that for higher differences, the probability of equivalency of the three types of understanding greatly diminishes (Table 29)

Test Statistics[a,b]

	Time
Chi-Square	52.804
df	2
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: Type

Table 29. Kruskal-Wallis Test comparing Condition 109 (Time)

Finally, KW-P, although it may take more effort in most cases, is the overall best in terms of time than its couterparts.

This concludes the analysis of level 2.

Level 3

Level 3 presents a similar challenge for analysis than level 2. Unlike level 2, level 3 contains even more initial conditions. Table 30 shows the settings for level 3.

Condition\Factor	K_α	K_β	W_α	W_β	P_α	P_β	WO
2	L	L	L	L	L	H	L
10	L	L	L	H	L	H	L
14	L	L	H	H	L	H	L
17	L	L	L	L	H	L	L
19	H	L	L	L	H	L	L
21	L	L	H	L	H	L	L
29	L	L	H	H	H	L	L
31	H	L	H	H	H	L	L
34	L	L	L	L	L	H	H
42	L	L	L	H	L	H	H
46	L	L	H	H	L	H	H
49	L	L	L	L	H	L	H
51	H	L	L	L	H	L	H
53	L	L	H	L	H	L	H
61	L	L	H	H	H	L	H
63	H	L	H	H	H	L	H
66	L	H	L	L	L	H	L
68	H	H	L	L	L	H	L
76	H	H	L	H	L	H	L
78	L	H	H	H	L	H	L
80	H	H	H	H	L	H	L
83	H	H	L	L	H	L	L
87	H	H	H	L	H	L	L
95	H	H	H	H	H	L	L
98	L	H	L	L	L	H	H
100	H	H	L	L	L	H	H
108	H	H	L	H	L	H	H
110	L	H	H	H	L	H	H
112	H	H	H	H	L	H	H
115	H	H	L	L	H	L	H
119	H	H	H	L	H	L	H
127	H	H	H	H	H	L	H

Table 30. Level 3 Initial Conditions

What can be immediately observed that makes these conditions different from level 1 and 2, is that problem is now a mix of settings between types in all cases (high and low). Like level 1, in level 3 there are conditions with only one type of either knowledge or worldview at high level (condition 10 for instance), and like level 2, there are conditions with at least one knowledge and one worldview type at high level (condition 14 for instance). What it is of even more interest is that condition 2 reflects all settings at low level, but one type of problem at high (P_β). Comparing condition 2 from level 3 and condition 1 from level 1 it can be said that this individual found this problem more difficult. The same can be said as one goes up in terms of levels. Notice that a problem type is either high while the other remains low and vice versa. There are no instances of both being at high setting.

Another behavior to notice is that the variation among means is more "erratic" than on the previous level. This can be seen when considering the Tamhane's T2 test in Appendix I.

Whereas in level 2 there were only three conditions (3, 15, and 109) that were generating not comparable values, in level 3 there are at least eight conditions, namely 2, 17, 34, 42, 49, 83, 100, and 115. These conditions are the upper extreme values as it can be observed in Figure 43. Excluding these extreme conditions, the remaining conditions are statistically equivalent (except for the pairs 61 and 80 and 68 and 80). This equivalency makes them comparable. So, in terms of effort, as it was mentioned, it is about the combination of factor settings what makes effort higher or lower.

The Tamhane's T2 test without the upper values can be found in Appendix J.

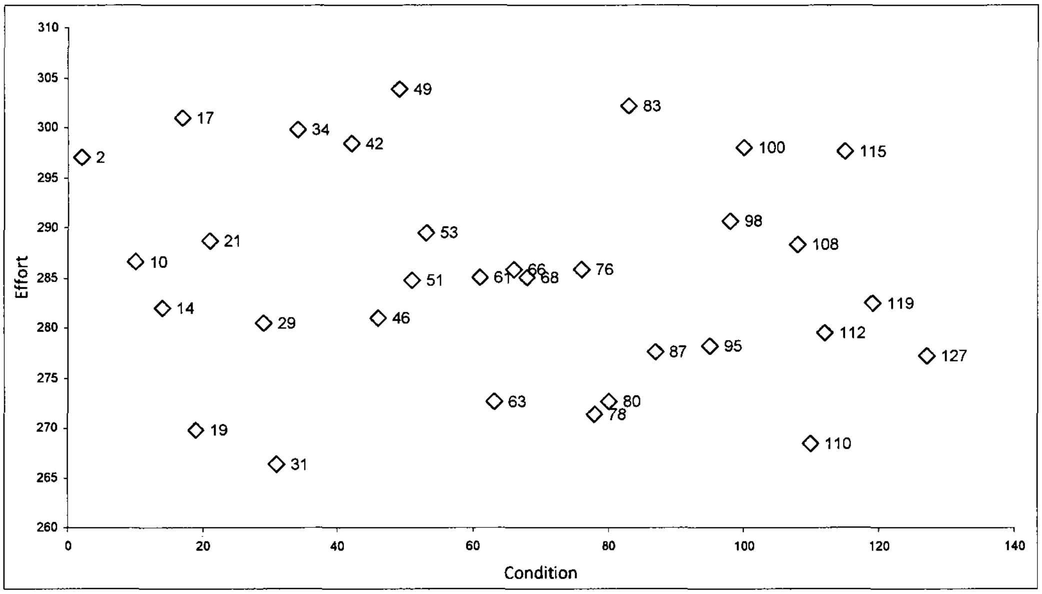

Figure 43. Plot of Means for Level 3 (Effort)

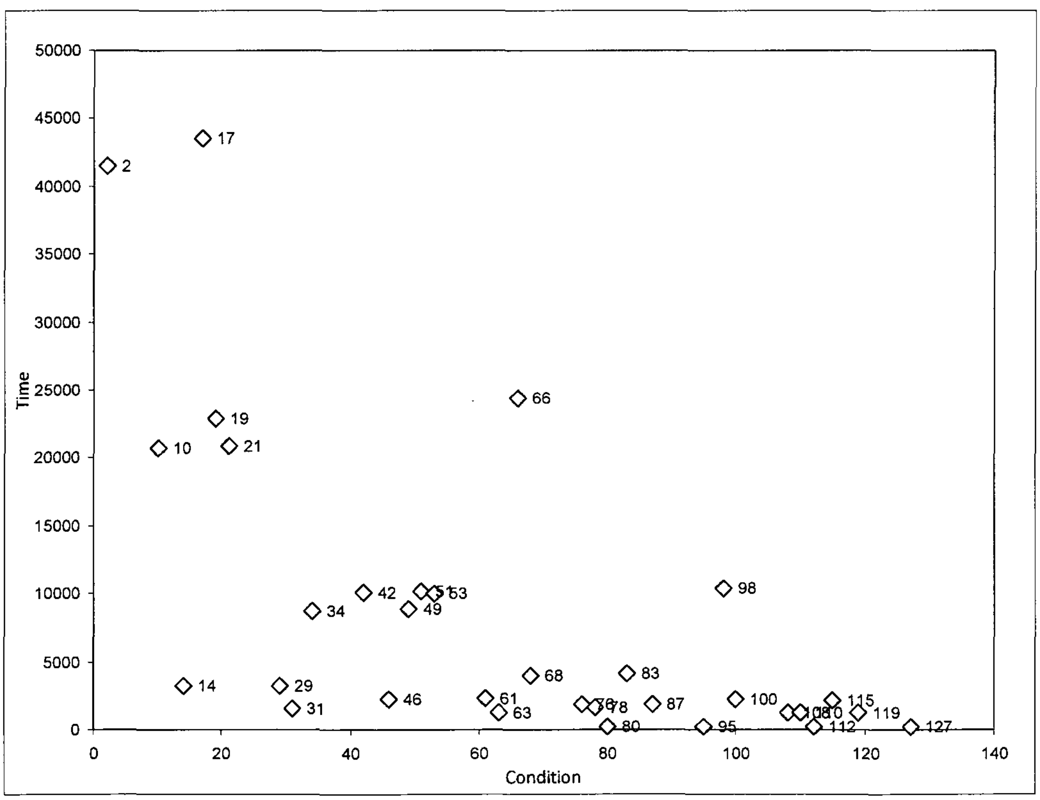

Figure 44. Plot of Means for Level 3 (Time)

Figure 44 shows level 3 in terms of time. As can be seen, when moving towards high numbered conditions, understanding becomes more efficient. As in level 2, it appears that high settings are conducive to faster understanding.

The three types of understanding, in terms of effort, are comparable. As in level 2, KW-P appears to be the one that takes more effort. In terms of time, as it occurs in previous levels, KW-P appears to perform better than its counterparts in most conditions (Figure 45 and Figure 46 respectively).

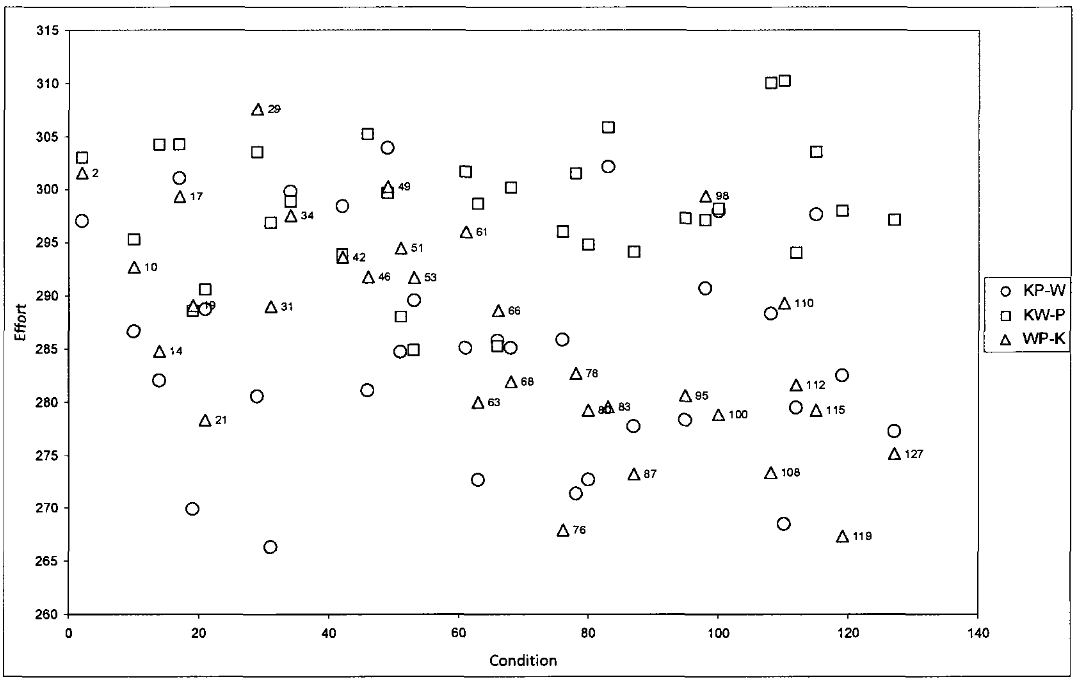

Figure 45. Comparison of Means for KP-W, KW-P, and WP-K at Level 3 (Effort)

As previously mentioned, a deeper analysis of this level repeats some of the previous findings.

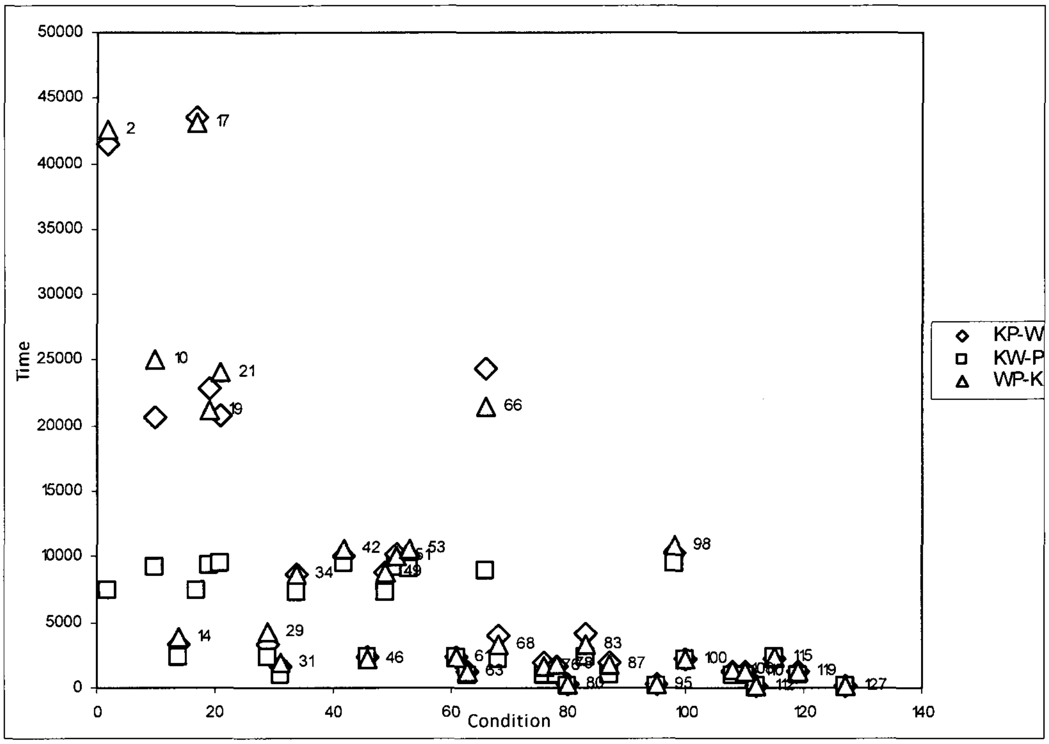

Figure 46. Comparison of Means for KP-W, KW-P, and WP-K at Level 3 (Time)

This concludes the analysis of level 3.

Level 4

Level 4 is similar to level 1 in the number of initial conditions and in the settings for knowledge, worldview, and WO. Unlike level 1, level 4 has all problem settings at high. Table 31 shows the settings for level 4.

Condition\Factor	K_α	K_β	W_α	W_β	P_α	P_β	WO
18	L	L	L	L	H	H	L
30	L	L	H	H	H	H	L
50	L	L	L	L	H	H	H
62	L	L	H	H	H	H	H
84	H	H	L	L	H	H	L
96	H	H	H	H	H	H	L
116	H	H	L	L	H	H	H
128	H	H	H	H	H	H	H

Table 31. Level 4 Initial Conditions

Unlike previous levels, in level 4 about half of the conditions are not statistically equivalent. This can be observed in Figure 47 and it is confirmed by the Tamhane's T2 test in Table 32. This is despite the closeness of the averages, which range from 521 to 586. Conditions 62 and 84 suggest splitting the level in two, upper and lower values.

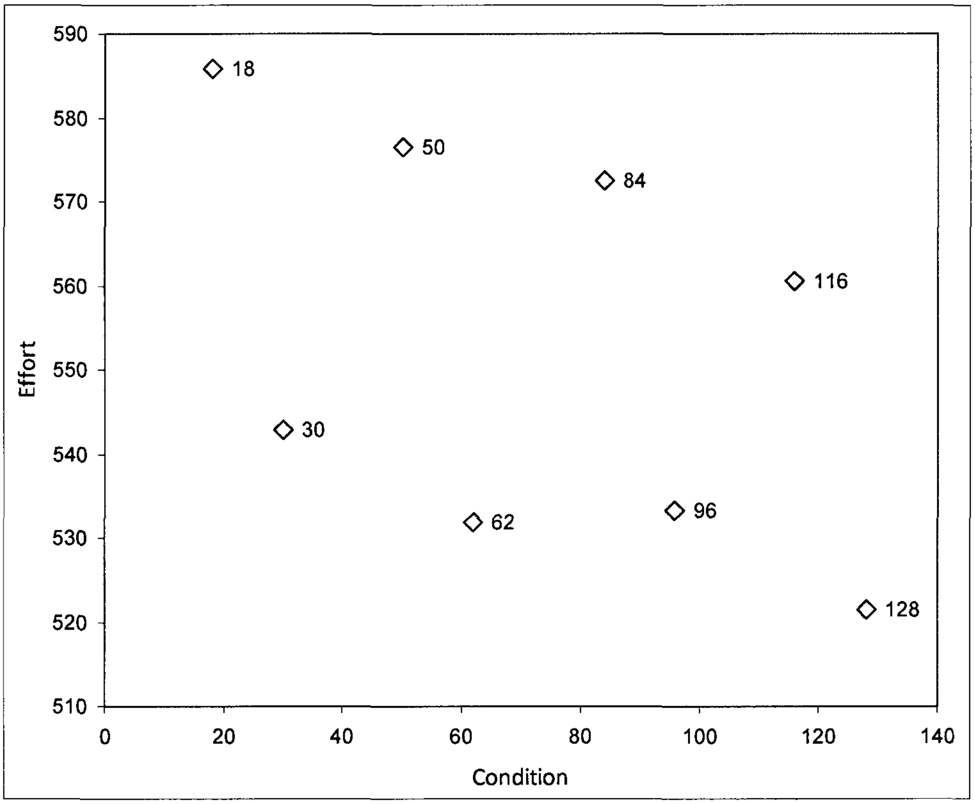

Figure 47. Plot of Means for Level 4 (Effort)

Multiple Comparisons

Dependent Variable: Effort
Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
18.00	30.00	42.96000*	4.38347	.000	29.2241	56.6959
	50.00	9.23600	4.38575	.639	-4.5070	22.9790
	62.00	53.98400*	4.34729	.000	40.3611	67.6069
	84.00	13.28400	4.33006	.062	-.2851	26.8531
	96.00	52.59200*	4.16133	.000	39.5490	65.6350
	116.00	25.25200*	4.45001	.000	11.3081	39.1959
	128.00	64.26800*	4.18689	.000	51.1455	77.3905
30.00	18.00	-42.96000*	4.38347	.000	-56.6959	-29.2241
	50.00	-33.72400*	4.11447	.000	-46.6160	-20.8320
	62.00	11.02400	4.07345	.179	-1.7395	23.7875
	84.00	-29.67600*	4.05505	.000	-42.3818	-16.9702
	96.00	9.63200	3.87436	.312	-2.5087	21.7727
	116.00	-17.70800*	4.18290	.001	-30.8145	-4.6015
	128.00	21.30800*	3.90180	.000	9.0816	33.5344
50.00	18.00	-9.23600	4.38575	.639	-22.9790	4.5070
	30.00	33.72400*	4.11447	.000	20.8320	46.6160
	62.00	44.74800*	4.07590	.000	31.9768	57.5192
	84.00	4.04800	4.05752	1.000	-8.6656	16.7616
	96.00	43.35600*	3.87694	.000	31.2072	55.5048
	116.00	16.01600*	4.18529	.004	2.9021	29.1299
	128.00	55.03200*	3.90436	.000	42.7975	67.2665
62.00	18.00	-53.98400*	4.34729	.000	-67.6069	-40.3611
	30.00	-11.02400	4.07345	.179	-23.7875	1.7395
	50.00	-44.74800*	4.07590	.000	-57.5192	-31.9768
	84.00	-40.70000*	4.01591	.000	-53.2832	-28.1168
	96.00	-1.39200	3.83338	1.000	-13.4040	10.6200
	116.00	-28.73200*	4.14497	.000	-41.7197	-15.7443
	128.00	10.28400	3.86111	.201	-1.8147	22.3827
84.00	18.00	-13.28400	4.33006	.062	-26.8531	.2851
	30.00	29.67600*	4.05505	.000	16.9702	42.3818
	50.00	-4.04800	4.05752	1.000	-16.7616	8.6656
	62.00	40.70000*	4.01591	.000	28.1168	53.2832
	96.00	39.30800*	3.81383	.000	27.3574	51.2586
	116.00	11.96800	4.12689	.104	-.9632	24.8992
	128.00	50.98400*	3.84170	.000	38.9463	63.0217
96.00	18.00	-52.59200*	4.16133	.000	-65.6350	-39.5490
	30.00	-9.63200	3.87436	.312	-21.7727	2.5087
	50.00	-43.35600*	3.87694	.000	-55.5048	-31.2072
	62.00	1.39200	3.83338	1.000	-10.6200	13.4040
	84.00	-39.30800*	3.81383	.000	-51.2586	-27.3574
	116.00	-27.34000*	3.94949	.000	-39.7167	-14.9633
	128.00	11.67600*	3.65046	.040	.2379	23.1141
116.00	18.00	-25.25200*	4.45001	.000	-39.1959	-11.3081
	30.00	17.70800*	4.18290	.001	4.6015	30.8145
	50.00	-16.01600*	4.18529	.004	-29.1299	-2.9021
	62.00	28.73200*	4.14497	.000	15.7443	41.7197
	84.00	-11.96800	4.12689	.104	-24.8992	.9632
	96.00	27.34000*	3.94949	.000	14.9633	39.7167
	128.00	39.01600*	3.97641	.000	26.5552	51.4768
128.00	18.00	-64.26800*	4.18689	.000	-77.3905	-51.1455
	30.00	-21.30800*	3.90180	.000	-33.5344	-9.0816
	50.00	-55.03200*	3.90436	.000	-67.2665	-42.7975
	62.00	-10.28400	3.86111	.201	-22.3827	1.8147
	84.00	-50.98400*	3.84170	.000	-63.0217	-38.9463
	96.00	-11.67600*	3.65046	.040	-23.1141	-.2379
	116.00	-39.01600*	3.97641	.000	-51.4768	-26.5552

*. The mean difference is significant at the .05 level.

Table 32. Tamhane's T2 Test for Level 4 (Effort)

To discriminate between upper and lower values on level 4, a comparison of means is conducted on conditions 18, 50, 84, and 116. However, the F-test shows that they are not statistically equivalent (Table 33).

ANOVA

Effort

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	82222.715	3	27407.572	12.092	.000
Within Groups	2257562	996	2266.629		
Total	2339785	999			

Table 33. F Test for Level 4 (Upper Values)

It can be concluded without further tests, that most conditions in level 4 are not equivalent. In this case, the questions left to ask are: what is the effect of WO or do high settings make a difference in terms of effort. From the Tamhane's T2 test, comparing conditions 18 and 50, it can be concluded that the two are statistically equivalent rendering WO, in this case, of no impact in terms of effort. Comparing conditions 62 and 128 it can be concluded that high settings do not play a role in terms of effort either in this particular case.

This level shows an insight previously mentioned:

- High problem setting does not imply a more "complex" problem. This is just level 4, in terms of effort, which means that there are other 3 levels that take more effort in terms of understanding. Despite low settings on knowledge, worldview, and WO, effort is low compared to levels 5, 6, and 7.

Figure 48 shows the plot of means for level 4 in terms of time. It can be observed that level 4 has an overall behavior similar to level 1 and level 3; an almost distinctive power graph that as knowledge, worldview, and WO goes higher in settings, the closer it gets to zero.

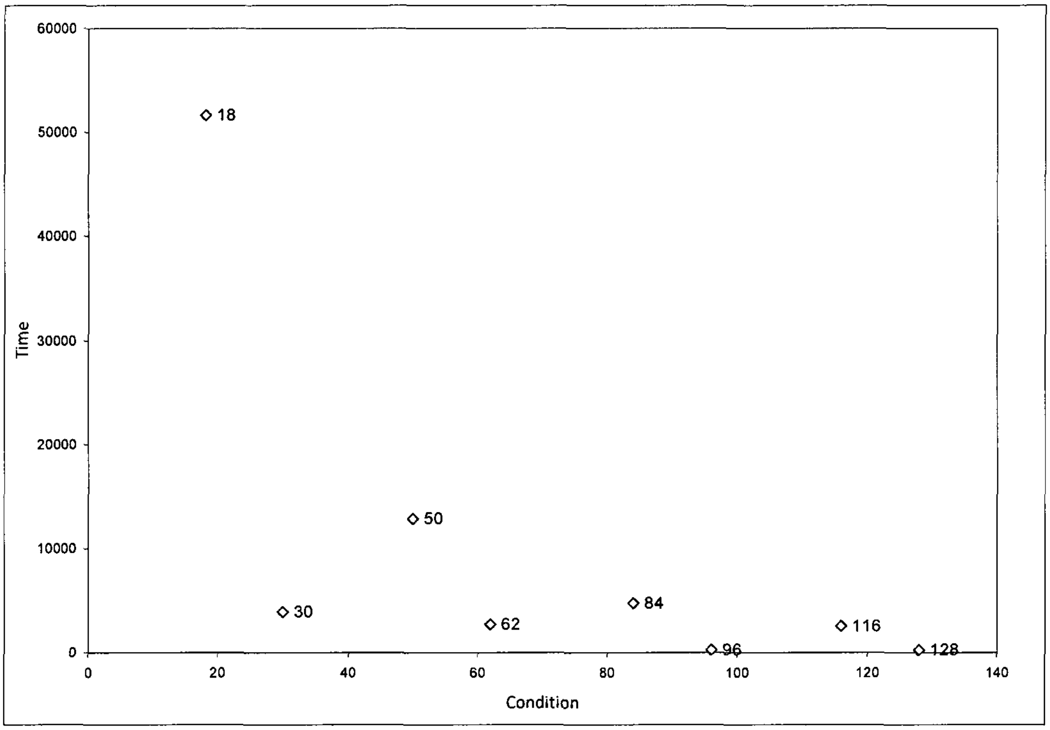

Figure 48. Plot of Means for Level 4 (Time)

A Tamhane's T2 test was conducted and it is shown in Table 34.

Multiple Comparisons

Dependent Variable: Effort
Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
18.00	30.00	46050.640*	549.22819	.000	44499.6101	47601.6699
	50.00	37843.504*	553.49055	.000	36280.8426	39406.1654
	84.00	47066.308*	547.67621	.000	45519.5092	48613.1068
	128.00	50611.360*	545.60645	.000	49070.2005	52152.5195
30.00	18.00	-46050.640*	549.22819	.000	-47601.6699	-44499.6101
	50.00	-8207.1360*	112.44748	.000	-8523.5440	-7890.7280
	84.00	1015.66800*	79.00555	.000	793.4231	1237.9129
	128.00	4560.72000*	63.07967	.000	4382.5460	4738.8940
50.00	18.00	-37843.504*	553.49055	.000	-39406.1654	-36280.8426
	30.00	8207.13600*	112.44748	.000	7890.7280	8523.5440
	84.00	9222.80400*	104.60431	.000	8928.1973	9517.4107
	128.00	12767.856*	93.16239	.000	12504.7064	13031.0056
84.00	18.00	-47066.308*	547.67621	.000	-48613.1068	-45519.5092
	30.00	-1015.6680*	79.00555	.000	-1237.9129	-793.4231
	50.00	-9222.8040*	104.60431	.000	-9517.4107	-8928.1973
	128.00	3545.05200*	47.71447	.000	3410.2815	3679.8225
128.00	18.00	-50611.360*	545.60645	.000	-52152.5195	-49070.2005
	30.00	-4560.7200*	63.07967	.000	-4738.8940	-4382.5460
	50.00	-12767.856*	93.16239	.000	-13031.0056	-12504.7064
	84.00	-3545.0520*	47.71447	.000	-3679.8225	-3410.2815

*. The mean difference is significant at the .05 level.

Table 34. Tamhane's T2 Test for Normally Distributed Conditions in Level 4 (Time)

Table 34 shows that these five conditions are not statistically equivalent. All that can be said is that they are different and that the higher the value, the more time it takes to reach understanding.

Comparing the three types of understanding in terms of effort and time (Figure 49 and Figure 50 respectively), it can be observed that the previous insights of one type may be better than the other whether in other conditions are equivalent still stand.

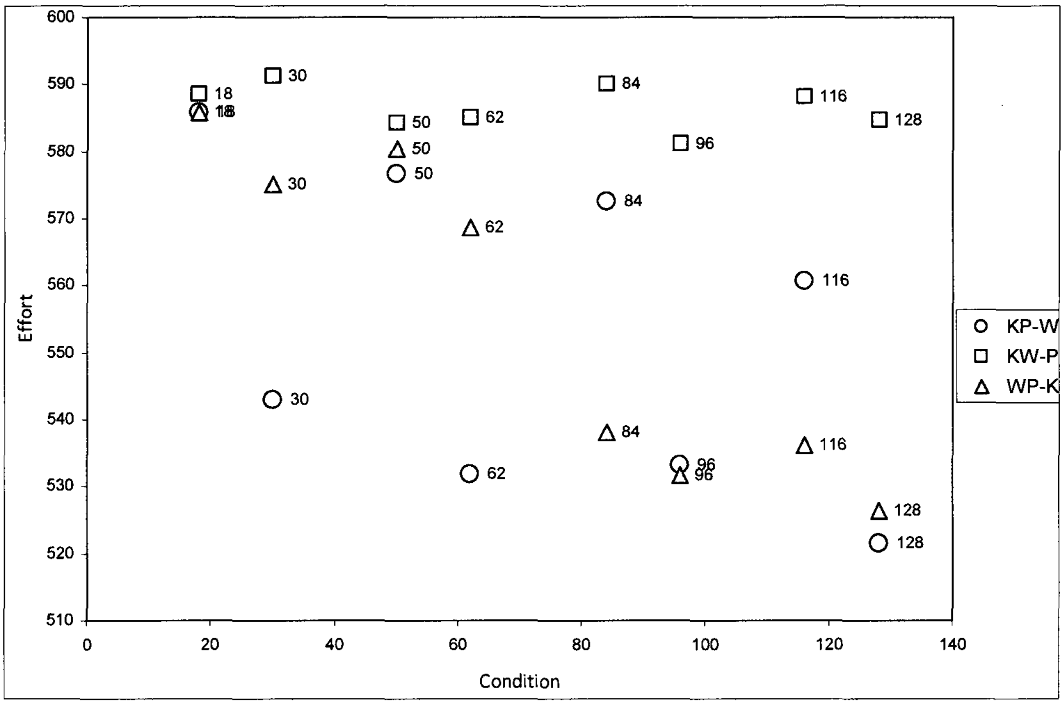

Figure 49. Comparison of Means of KP-W, KW-P, and WP-K at Level 4 (Effort)

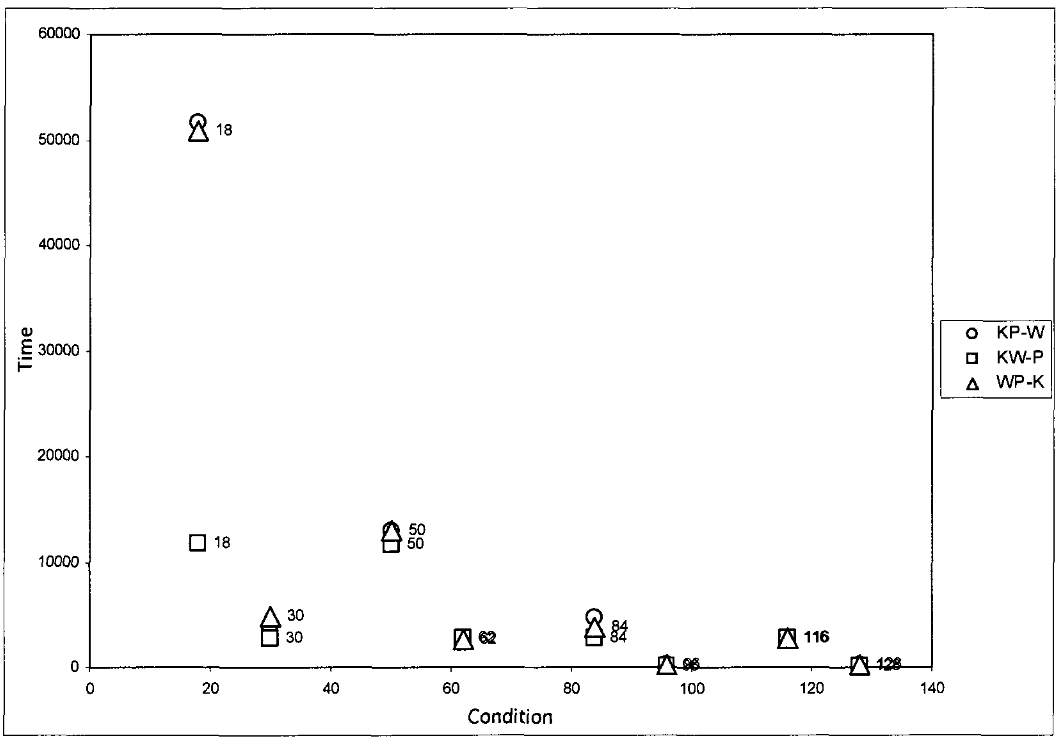

Figure 50. Comparison of Means for KP-W, KW-P, and WP-K at Level 4 (Time)

This concludes the analysis of level 4.

Level 5

Table 35 shows level 5 initial conditions.

Condition\Factor	K_α	K_β	W_α	W_β	P_α	P_β	WO
7	H	L	H	L	L	L	L
12	H	L	L	H	L	H	L
23	H	L	H	L	H	L	L
27	H	L	L	H	H	L	L
39	H	L	H	L	L	L	H
44	H	L	L	H	L	H	H
55	H	L	H	L	H	L	H
59	H	L	L	H	H	L	H
70	L	H	H	L	L	H	L
73	L	H	L	H	L	L	L
74	L	H	L	H	L	H	L
85	L	H	H	L	H	L	L
102	L	H	H	L	L	H	H
105	L	H	L	H	L	L	H
106	L	H	L	H	L	H	H
117	L	H	H	L	H	L	H

Table 35. Level 5 Initial Conditions

Level 5 distinguishing characteristics are:

- There is one high knowledge setting per condition, not both. All previous levels had conditions where knowledge had both types at high settings.
- Problem settings are all low or a mix of high and low. This is truly a combination of problem setting from previous levels.
- Worldview settings are low or a mix of high and low. It is the same behavior than knowledge.
- More importantly, when problem settings are at low, knowledge and worldview settings both coincide at high or low setting on either type (conditions 7, 39, 73, and 105).

- When one problem setting is high, two cases occur: first where one corresponding knowledge type and one corresponding worldview type are high (conditions 23, 55, 74, and 106). The other, where one corresponding knowledge or worldview is paired up with a non corresponding knowledge or worldview type (conditions 12, 27, 44, 59, 70, 85, 102, and 117).

Appendix K shows that Tamhane's T2 test for level 5, excluding conditions 55 and 105 because they are not normally distributed. However, conditions 55 and 105 are considered within the group for overall assessment.

From Appendix K two forms of grouping are possible; however, one provides a particular separation on two groups. One group contains conditions 27, 44, 59, 70, 85, 102, and 117 and the other conditions 7, 12, 23, 39, 73, 74, and 106. These groupings separate those conditions with high problem setting with the paired up corresponding knowledge or worldview type with non corresponding knowledge or worldview type as one group (with the exception of condition 12). The second group is formed by those conditions with coinciding knowledge and worldview type regardless of problem setting. Condition 12 does not belong to the first group because it takes less effort. This is due to the availability of proper worldview when the KP match first occurs despite the high likelihood of initial mismatches due to high numbers of K_α and P_β. This is counterintuitive, especially when compared with condition 27. Condition 27 has, apparently, the perfect initial setting to deal with the problem (K_α at high for P_α at high). However, do consider that W_β is at high level generating many mismatches which amounts to high effort. On condition 12, it happens the other way around; there are few initial mismatches due to the low K_α.

Figure 51 shows this level. The upper values correspond to the first group while the lower values to the second.

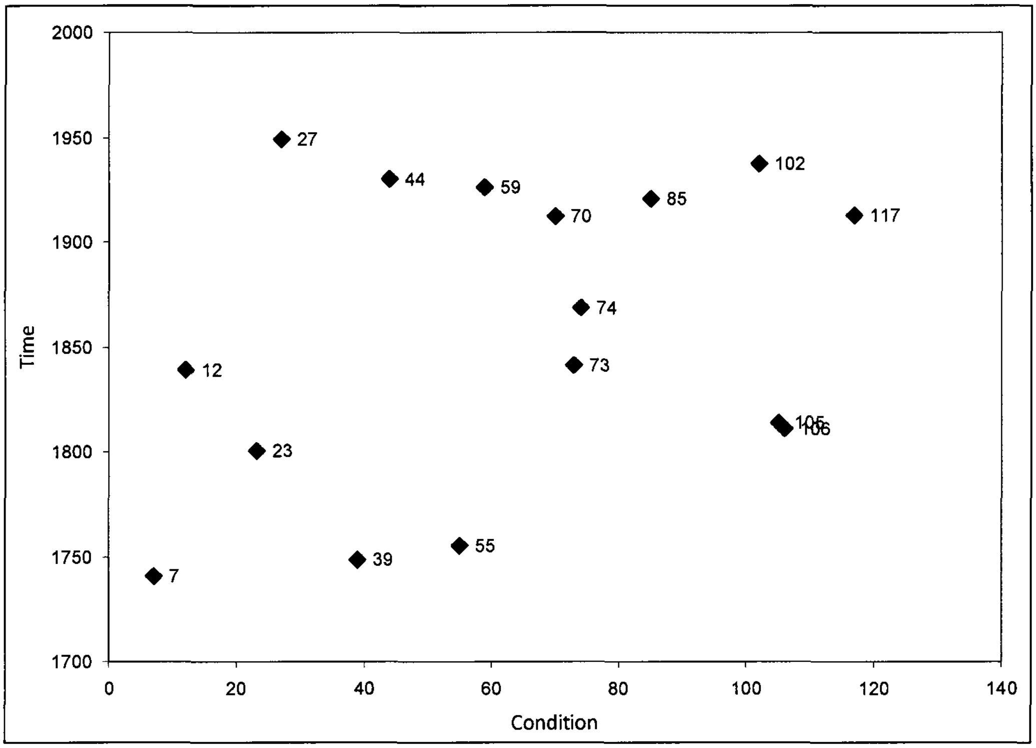

Figure 51. Plot of Means for Level 5 (Effort)

The previously mentioned characteristics mean:

- For group one, a problem with one high setting that is matched with non corresponding knowledge or worldview type at high settings, will correspond to a lower degree of effort (compared to group 2). Also notice that at this level it is much more evident the fact that higher setting levels does not imply less effort. Comparing conditions 27 and 17 (from level 3), for instance, the former takes more effort regardless of higher knowledge and worldview settings with the same problem and WO setting. This is evidence that complexity, viewed from an understanding perspective, is about the mismatch of types more than the high settings of problem and/or of WO. On the following levels this mismatch is taken gradually to the extreme, making for extreme efforts to understand. Furthermore, there are conditions that are at low setting, (condition 73 for instance), take more effort than counterparts with higher problem setting and similar knowledge and worldview combinations (condition 84). This implies that complexity does not necessarily depend on the higher problem setting.

- Group two, formed by those conditions with coinciding knowledge and worldview type regardless of problem setting, take more effort due to the matching of high knowledge and worldview setting when problem is at low setting, and the matching of high knowledge and worldview setting with one of problem setting at high because it corresponds to the type at high setting of knowledge and worldview.
- *From both groups, intuitive possible outcomes may not be true after all.* Each condition, within a type of understanding must be evaluated.
- Finally, when considering better understanding, it is not only about taking into account what conditions to seek but also what conditions to avoid. The higher the level, the more aware an individual needs to be in order to avoid higher effort.

Figure 52 shows the means in terms of time. The behavior of time at this level is similar to that of level 2, apparently erratic. It is not like the other levels (besides 2) where, as it was mentioned, the higher the knowledge and worldview setting and WO, the closer to zero in terms of time. This is because knowledge and worldview exist at similar settings. WO helps in the variation of the means. The inherent purpose of this analysis, as before, was to have an idea on the effect of WO. However, all cases where WO is at high perform better than at low setting. Take for instance conditions 12 and 44 take look apparently in close proximity to one another. Conducting a Mann-Whitney Test, it was found that the difference on WO matters (see Table 36).

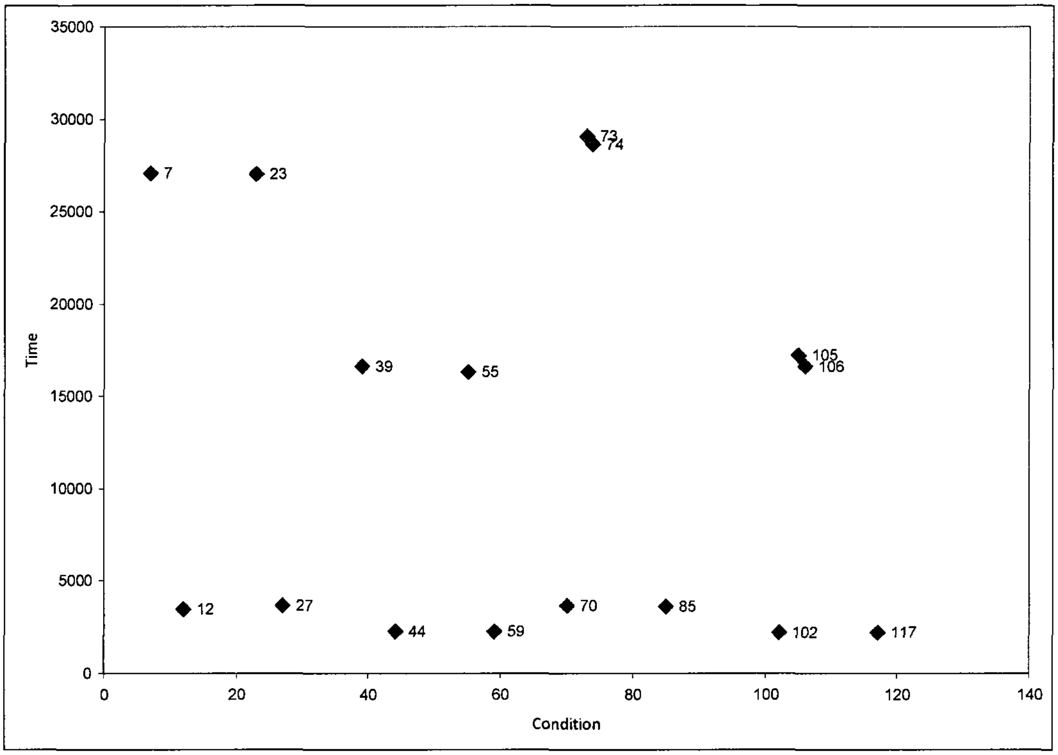

Figure 52. Plot of Means for Level 5 (Time)

Test Statistics[a]

	Time
Mann-Whitney U	5244.000
Wilcoxon W	36619.000
Z	-16.099
Asymp. Sig. (2-tailed)	.000

a. Grouping Variable: Condition

Table 36. Mann-Whitney Test comparing Conditions 12 and 44 at Level 5 (Time)

To have an idea of the effect of time, it is better to use KW-P given that it does not depend on WO. Figure 53 shows the plot of means for level 5 in terms of time. As it can be observed, unlike Figure 52, Figure 53 shows a clear difference between the two groups within level 5 previously identified.

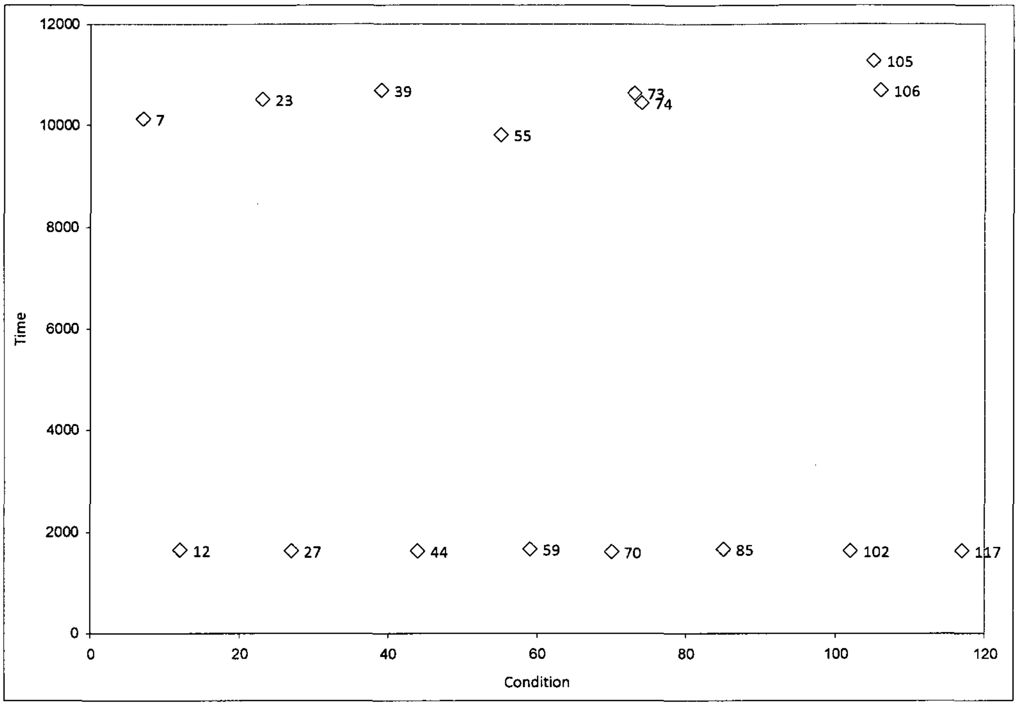

Figure 53. Plot of Means for KW-P at Level 5 (Time)

Table 37 shows the results of the Kruskal-Wallis Test comparing the conditions within group 1 (including condition 12). The test shows that the conditions within group 1 at level 5 are not statistically different.

Test Statistics[a,b]

	Time
Chi-Square	9.798
df	7
Asymp. Sig.	.200

a. Kruskal Wallis Test

b. Grouping Variable: Condition

Table 37. Kruskal-Wallis Test for Group 1 at Level 5 (Time)

This is an interesting development, especially when compared to effort. For instance, Table 37 says that condition 12 and condition 27 are equivalent in terms of time, but they could not be more different in terms of effort (see Appendix K).

This is an interesting change of events in the sense that up to this point, conditions for effort usually behave similarly while time is not. Here, both provide equal elements for comparison and insight generation.

Table 38 shows the results of the Kruskal-Wallis Test comparing the conditions within group 2. As can be observed, they are not statistically different in terms of time.

Test Statistics[a,b]

	Time
Chi-Square	10.834
df	7
Asymp. Sig.	.146

a. Kruskal Wallis Test

b. Grouping Variable: Condition

Table 38. Kruskal-Wallis Test for Group 2 at Level 5 (Time)

Unlike the analysis of time in previous levels that focused on higher settings as compared to lower settings, the focus here is on the combination of settings. For instance, comparing conditions 23 and 27; problem has the same setting, what changes is the high number of the type of worldview. Also, comparing the same conditions in terms of effort and time, it is shown that what may be beneficial in terms of effort it is not in terms of time and vice versa.

Figure 54 shows the means comparison of the three types of understanding in terms of effort.

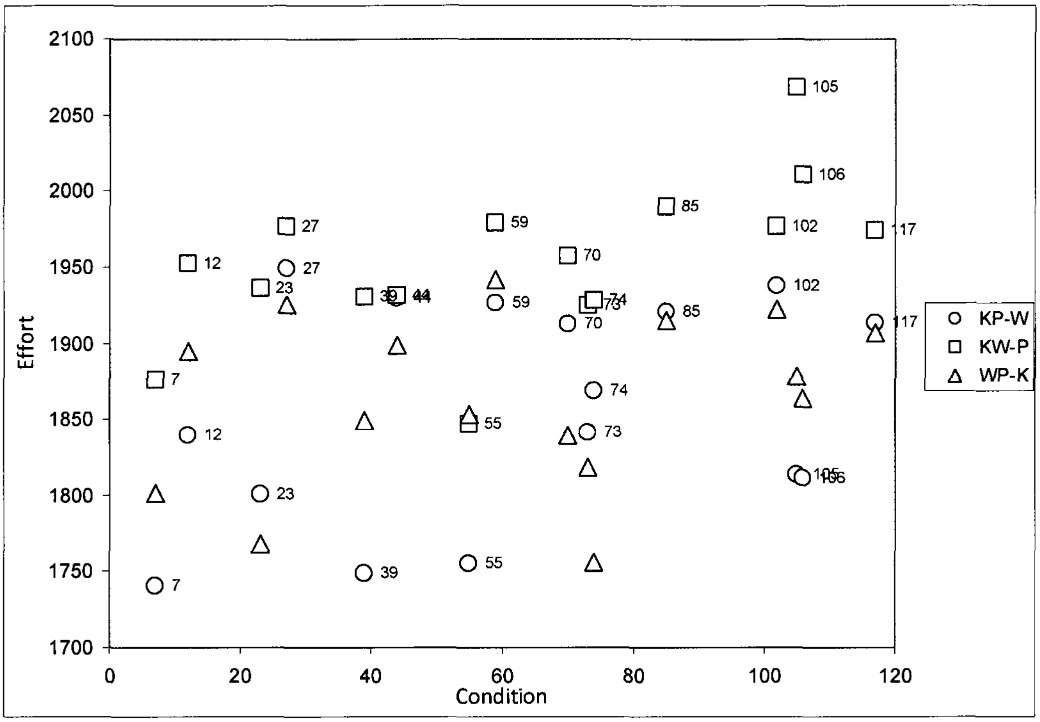

Figure 54. Comparison of Means for KP-W, KW-P, and WP-K at Level 5 (Effort)

As in previous levels, if one is to consider which is the best type, one must look into each individual case to seek the best condition or avoid the worse ones within the level.

Figure 55 shows the means comparison in terms of time. As in previous levels, KW-P seems to perform better than its counterparts in some conditions.

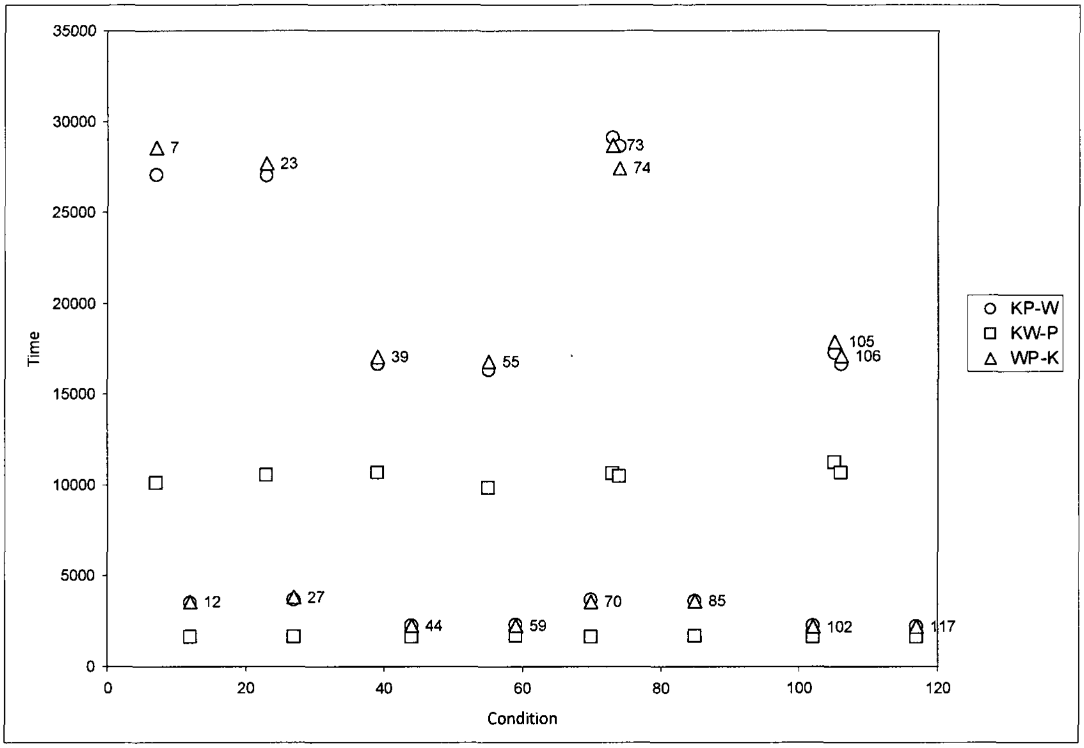

Figure 55. Comparison of Means for KP-W, KW-P, and WP-K at Level 5 (Time)

This concludes the analysis of level 5.

Level 6

Level 6 is perhaps the most challenging level for analysis because of the large number of initial conditions included (36). Table 39 shows the settings for level 6.

Condition\Factor	K_α	K_β	W_α	W_β	P_α	P_β	WO
4	H	L	L	L	L	H	L
6	L	L	H	L	L	H	L
16	H	L	H	H	L	H	L
20	H	L	L	L	H	H	L
22	L	L	H	L	H	H	L
25	L	L	L	H	H	L	L
26	L	L	L	H	H	H	L
28	H	L	L	H	H	H	L
32	H	L	H	H	H	H	L
36	H	L	L	L	L	H	H
38	L	L	H	L	L	H	H
48	H	L	H	H	L	H	H
52	H	L	L	L	H	H	H
54	L	L	H	L	H	H	H
57	L	L	L	H	H	L	H
58	L	L	L	H	H	H	H
60	H	L	L	H	H	H	H
64	H	L	H	H	H	H	H
72	H	H	H	L	L	H	L
81	L	H	L	L	H	L	L
82	L	H	L	L	H	H	L
86	L	H	H	L	H	H	L
88	H	H	H	L	H	H	L
91	H	H	L	H	H	L	L
92	H	H	L	H	H	H	L
93	L	H	H	H	H	L	L
94	L	H	H	H	H	H	L
104	H	H	H	L	L	H	H
113	L	H	L	L	H	L	H
114	L	H	L	L	H	H	H
118	L	H	H	L	H	H	H
120	H	H	H	L	H	H	H
123	H	H	L	H	H	L	H
124	H	H	L	H	H	H	H
125	L	H	H	H	H	L	H
126	L	H	H	H	H	H	H

Table 39. Level 6 Initial Conditions

As was the case in level 5, level 6 weighs more heavily the combination than the high settings of knowledge and worldview to generate more effort. At this point, an individual falls into the case of knowing "too much" of the wrong type of problem increasing the likelihood of using this type of knowledge and/or a type of worldview inappropriately. This situation, as can be seen, is more detrimental than having a problem at high setting or what it could be considered a "more complex" problem. These cases are those where an individual attempts to use knowledge about structure on a problem about behavior, or use knowledge about behavior on a problem about behavior with a worldview about structure.

Appendix L contains a Tamhane's T2 test on level 6 excluding conditions 4 and 6 because they are not normally distributed. However, conditions 4 and 6 are considered *within this level for assessment purposes.*

Tamhane's T2 test shows there is overlapping of conditions creating the possibility of many categorizations within the level. However, if categorizations were to be established there are conditions that would no abide by one category only. As can be seen in the test, one condition may belong to at least two different groupings. This impedes the generalization from the categorization. For this reason, there is no suggested grouping. This is paradoxical; suggested grouping may miss important combinations, and without grouping there is no way of establishing generalizations within the level. In addition, there are many possible explanations for the differentiation of categories. For instance, condition 20 more likely belongs to this level because of the opposite types of K and P. Condition 25, on the other hand, more likely belongs to this level because of the low K. All that can be said about the conditions of this level is that if they are equivalent different explanations may not make them comparable.

Figure 56 shows how a condition may be belong to different sub-groups within the level. Figure 56 also highlights the seemingly "erratic" behavior previously mentioned as the means vary greatly in values. This variation is what creates the different possible groupings.

This is an important finding; the fact that at this level no generalization within a level is possible further reassures the need to consider each condition separately.

What can be generalized from all groups is that the combination of extreme conditions may prompt an individual to see the problem situation as more complex due the steep effort required to understand.

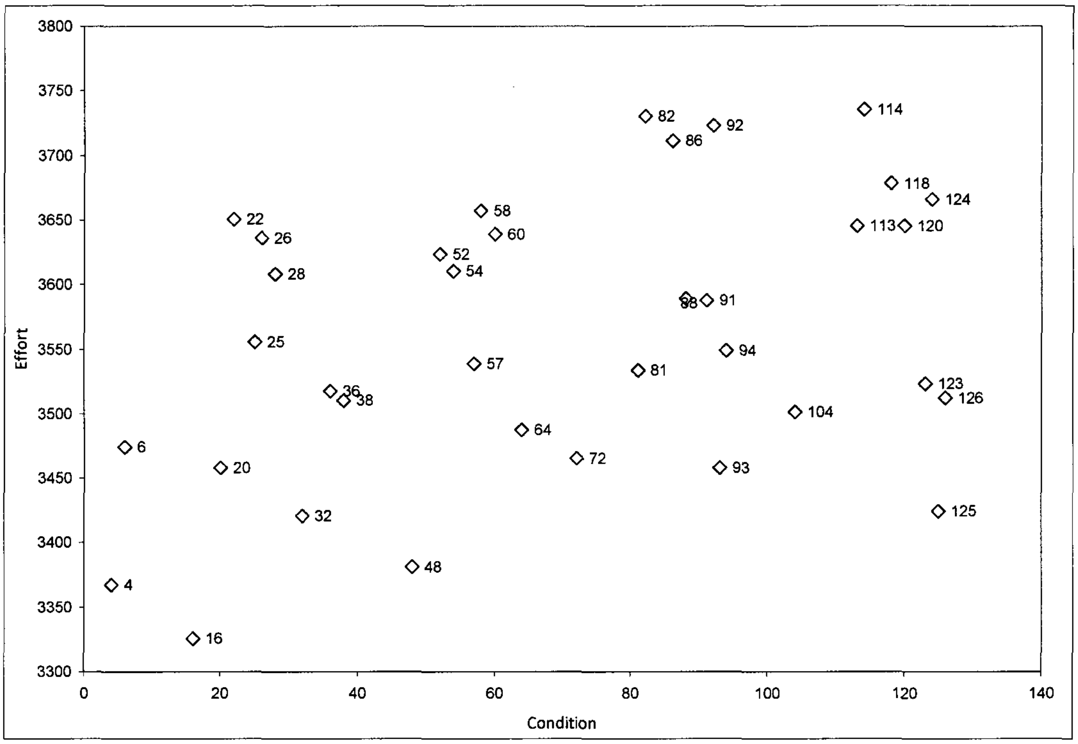

Figure 56. Plot of Means for Level 6 (Effort)

Focusing on time, the same behavior presented at level 5 can be observed: two clear groupings based on efficiency (Figure 57). As was the case for level 5, in this level better time does not mean less effort. Consider condition 4; in terms of time present a high value whereas in terms of effort is the second lowest value. Condition 16, on the other hand, is low in both time and effort (the lowest value). On the same token, condition 114 is high in both time and effort. In other words, each condition must be evaluated for time and effort and seek the one with better result while avoiding the ones with higher penalties keeping in mind possible trade offs.

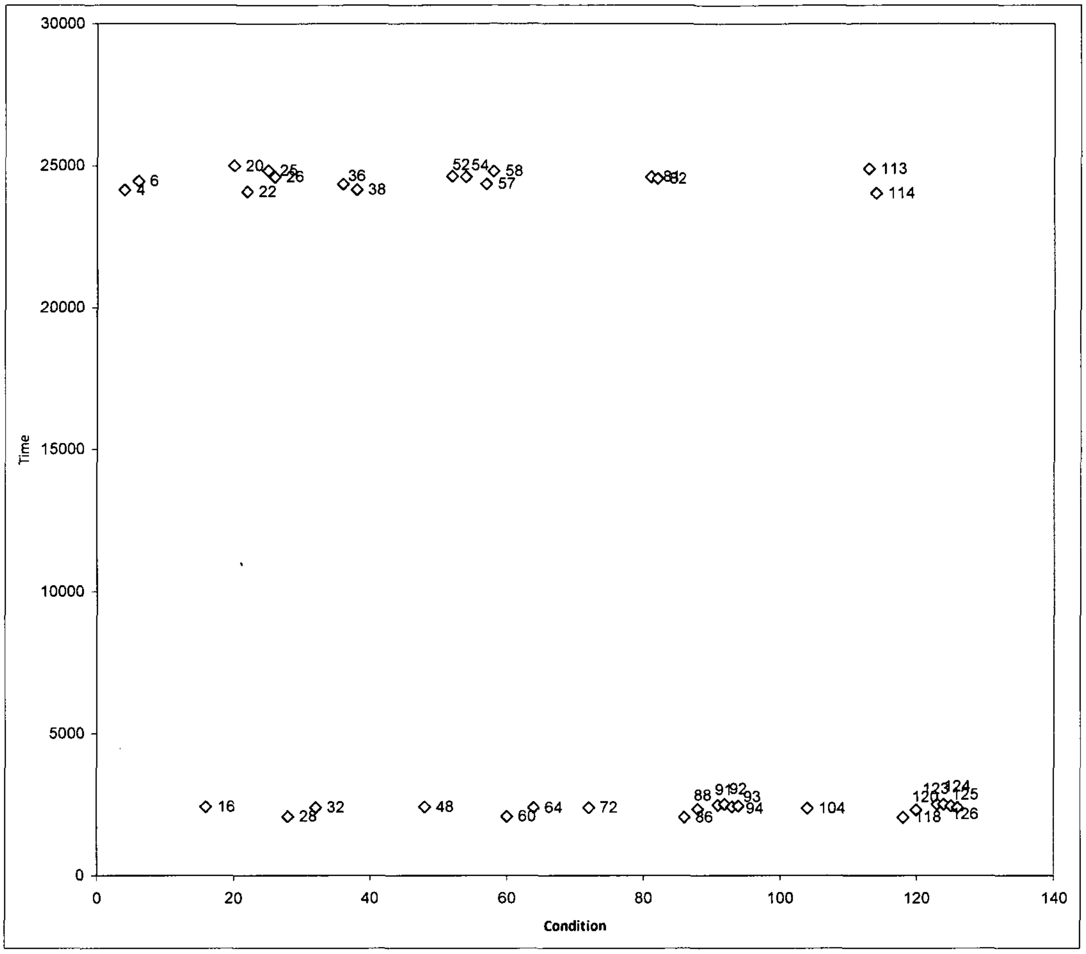

Figure 57. Plot of Means for KW-P at Level 6 (Time)

Figure 58 and Figure 59 show the comparison of means for effort and time respectively. As previously mentioned, whereas some conditions may be equivalent, some may not. Each condition needs to be evaluated individually if one needs to decide which type of understanding takes less effort

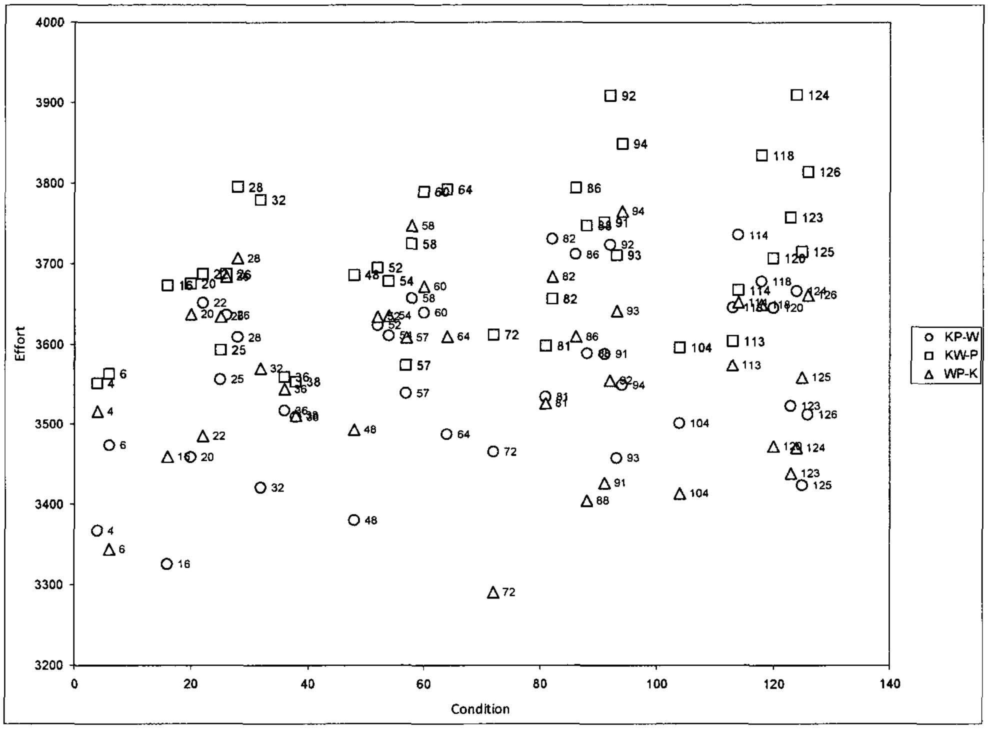

Figure 58. Comparison of Means for KP-W, KW-P, and WP-K at Level 6 (Effort)

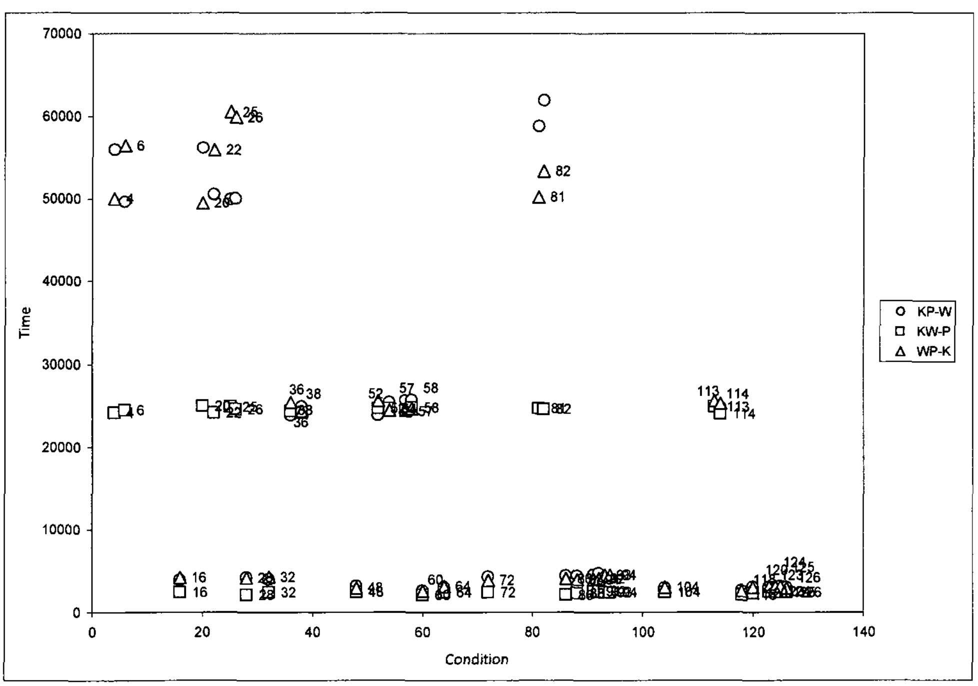

Figure 59. Comparison of Means for KP-W, KW-P, and WP-K at Level 6 (Time)

Although in terms of output there is no clear generalization, in terms of input there is. There are five groupings based on input:

- Group 1: One high setting of knowledge or worldview and one type of problem at high setting (1, 1).
- Group 2: One high setting of knowledge or worldview and problem at high setting (1, 2).
- Group 3: Two high setting of either knowledge, or worldview, or one and one and problem at high (2, 2).
- Group 4: Three high setting of knowledge and worldview (two and one or one and two) and one type of problem at high setting (3, 1).
- Group 5: Three high setting of knowledge and worldview (two and one or one and two) and one problem at high setting (3, 2).

These groupings, however, do not correspond to similar outputs. In other words, an individual within group 2 can be equivalent to an individual within group 5 such as the case of conditions 82 and 92 respectively (see appendix L).

This concludes the analysis of level 6.

Level 7

The difference between level 7 and the rest is significant. This means that the combinations of this level present certainly the most difficult challenge an individual may have when dealing with a problem situation. Table 40 shows this level's initial conditions.

Condition\Factor	K_α	K_β	W_α	W_β	P_α	P_β	WO
8	H	L	H	L	L	H	L
24	H	L	H	L	H	H	L
40	H	L	H	L	L	H	H
56	H	L	H	L	H	H	H
89	L	H	L	H	H	L	L
90	L	H	L	H	H	H	L
121	L	H	L	H	H	L	H
122	L	H	L	H	H	H	H

Table 40. Level 7 Initial Conditions

As level 1, this is a very straightforward case: the existence of one problem type at high setting (alpha or beta) and the opposite type of knowledge at high setting with the high setting of the corresponding worldview to the knowledge type. What this combination does is that when a mismatch of knowledge and problem occurs it gets exacerbated by the high setting of the worldview.

This shows two groupings based on input: 2, 1 (one type of knowledge and one type of worldview at high setting with one type of problem at high setting) and 2, 2 (one type of knowledge and one type of worldview at high setting with problem at high setting). Group 2,2 from level 7 and 6 are quite different. The one corresponding to level 6 is one type of knowledge at high and the opposite worldview at high as well with problem at high. The one corresponding to level 7 is one type of knowledge at high and the corresponding type of worldview at high with problem at high. In other words, for level 7, corresponding knowledge and worldview types do not work on the problem at hand. For level 6, there are not corresponding knowledge and worldview types. This allows balancing the problem out when at high setting.

Table 41 shows that the variances are homogeneous. Tukey HSD was then conducted to establish which conditions where statistically equivalent. However, like level 6, level 7 does not present a clear grouping based on the output (Table 42). Instead, four variable groupings are shown with no indication of how one is similar to the other. Two groups contain five variables whereas the other two contain three. From level 1 to 5, it was found that these groupings worked in even numbers which made easier generalizing from the output. This is not the case for level 6 and 7. In addition, notice conditions 8, 24, and 40. They are not statistically equivalent. However, WO is the same for 8 and 24, but not for 40. Even though WO is the same for 8 and 24, both have different problem setting. All that can be said is that the behavior seems erratic and that each condition needs to be evaluated independently to see if equivalence with other condition can be established.

Test of Homogeneity of Variances

Effort

Levene Statistic	df1	df2	Sig.
.963	7	1992	.457

Table 41. Levene Test for Level 7 (Effort)

Effort

Tukey HSD[a]

		Subset for alpha = .05			
Condition	N	1	2	3	4
8.00	250	33655.75			
24.00	250	34073.04	34073.04		
40.00	250	34597.27	34597.27	34597.27	
56.00	250		34678.32	34678.32	34678.32
90.00	250			35207.36	35207.36
122.00	250			35346.17	35346.17
89.00	250			35439.27	35439.27
121.00	250				35563.83
Sig.		.062	.550	.141	.100

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 250.000.

Table 42. Tukey HSD Comparing Conditions for Level 7

Figure 60 shows the plot of means for this level.

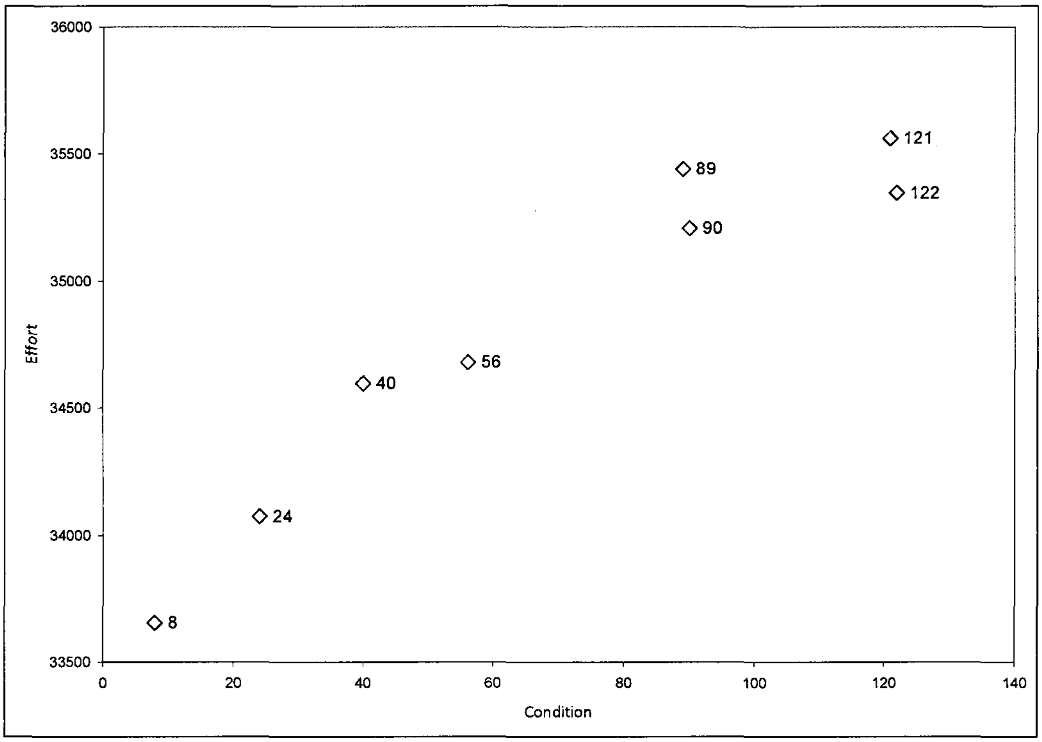

Figure 60. Plot of Means for Level 7 (Effort)

Figure 61 shows the plot of means in terms of time. Unlike effort, and like level 6, time in level 7 provides a distinguishable pattern. However, it is not a new pattern; it shows that WO has an effect on understanding. As in all cases, it shows that a high WO takes less time that a low WO.

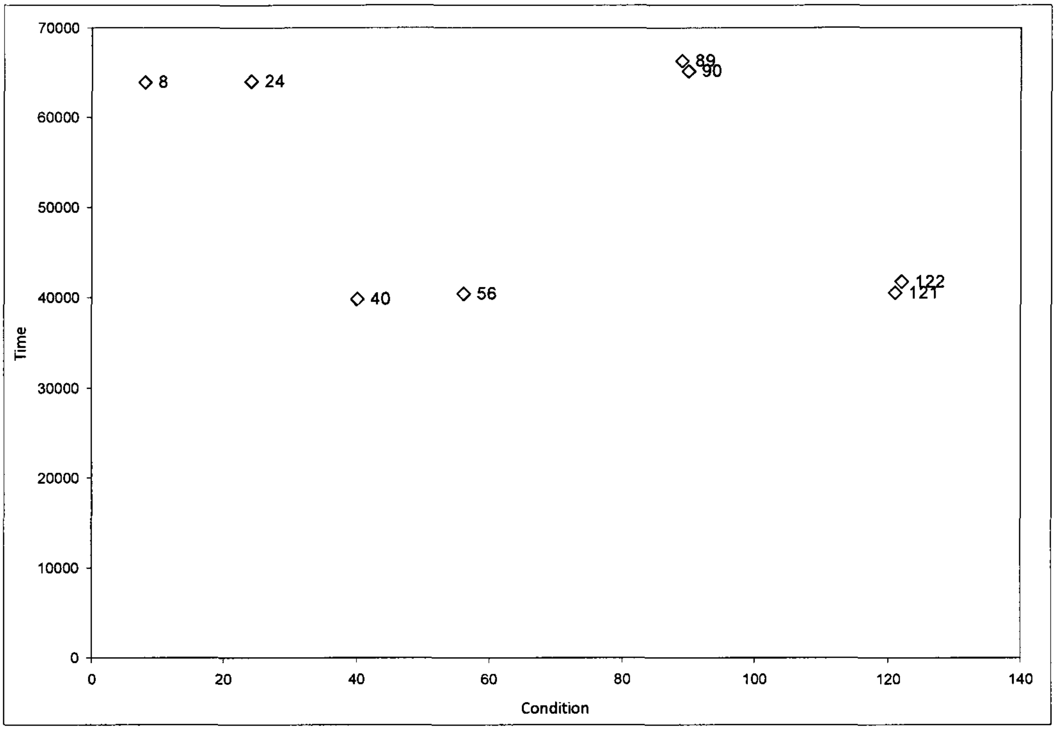

Figure 61. Plot of Means for Level 7 (Time)

As before, to have an idea about the behavior of understanding through time, it is better to look at KW-P given that it does not depend on WO. Figure 62 shows the plot of means for KW-P.

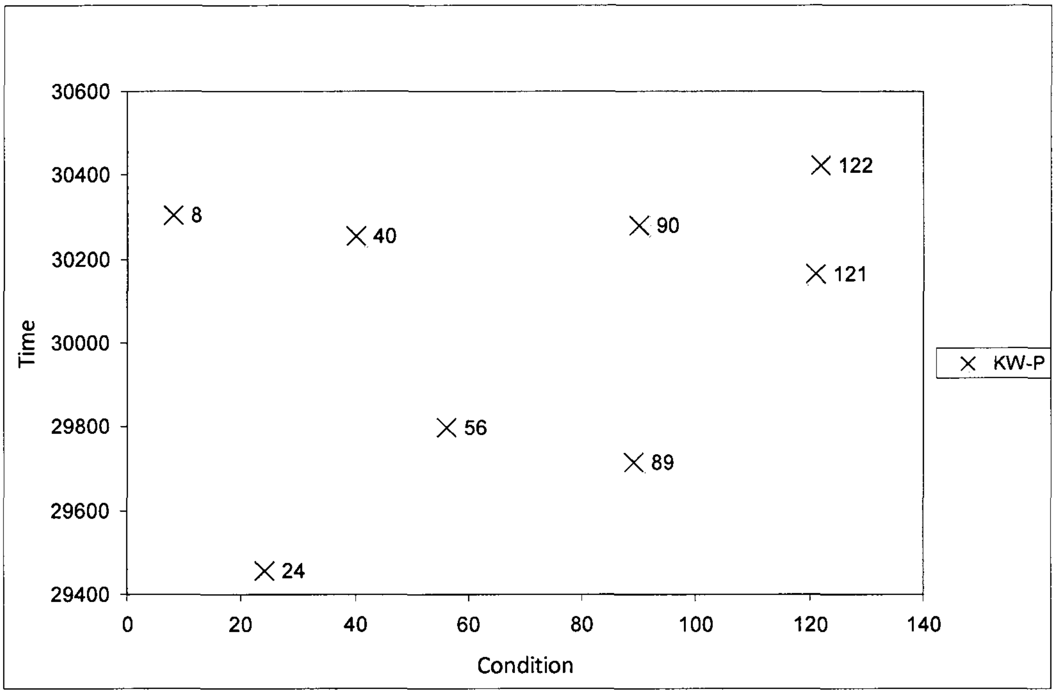

Figure 62. Plot of Means for KW-P at Level 7 (Time)

Figure 62 shows what seems like uneven groupings: conditions 24, 56, and 89 with low values and conditions 8, 40, 90, 121, and 122 with high values. However, conducting a Kruskal-Wallis test, it can be concluded that they all are statistically equivalent (Table 43).

Test Statistics[a,b]

	Time
Chi-Square	3.377
df	7
Asymp. Sig.	.848

a. Kruskal Wallis Test

b. *Grouping Variable: Condition*

Table 43. Kruskal-Wallis Test for Level 7 (Time)

Figure 63 shows the comparison of means for effort. KW-P seems to perform worse than its counterparts. As previously mentioned, whereas some conditions may be equivalent, some may not. Each condition needs to be evaluated individually if one needs to decide which type of understanding is better than another.

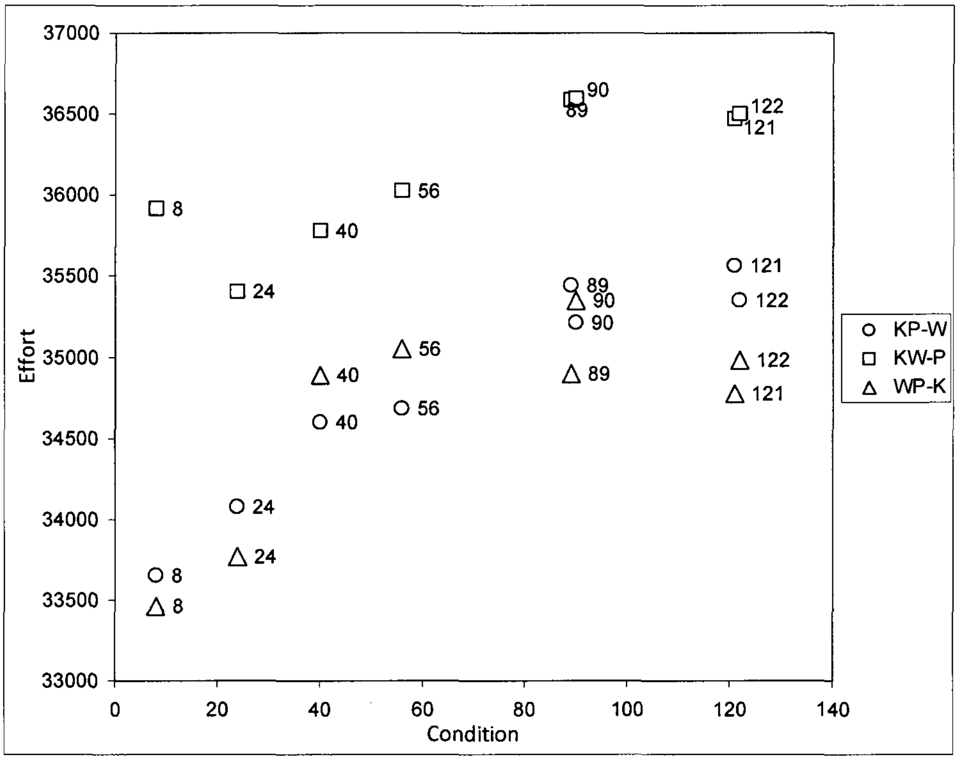

Figure 63. Comparison of Means for KP-W, KW-P, and WP-K at Level 7 (Effort)

Taking condition 8 as an example, it can be seen how KP-W (Type 1) and WP-K (Type 3) are statistically equivalent. In this case, as is the case of all this level, KW-P (Type 2) performs worse than its counterparts (see Table 44).

Effort

Tukey B[a]

Type	N	Subset for alpha = .05 1	2
3.00	250	33457.66	
1.00	250	33655.75	
2.00	250		35915.01

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 250.000.

Table 44. Tukey Test comparing Condition 8 (Effort)

Figure 64 shows the comparison of means for time. As before, KW-P seems to perform better than its counterparts in most conditions. Evaluating condition 56, for instance, it can be concluded that the three types of understanding are statistically different (Table 45). However, looking at the rank table (Table 46), it can be observed that KP-W and WP-K's ranks are close. Conducting a Mann-Whitney U Test for KP-W and WP-K it can be concluded that the two are not statistically different (Table 47).

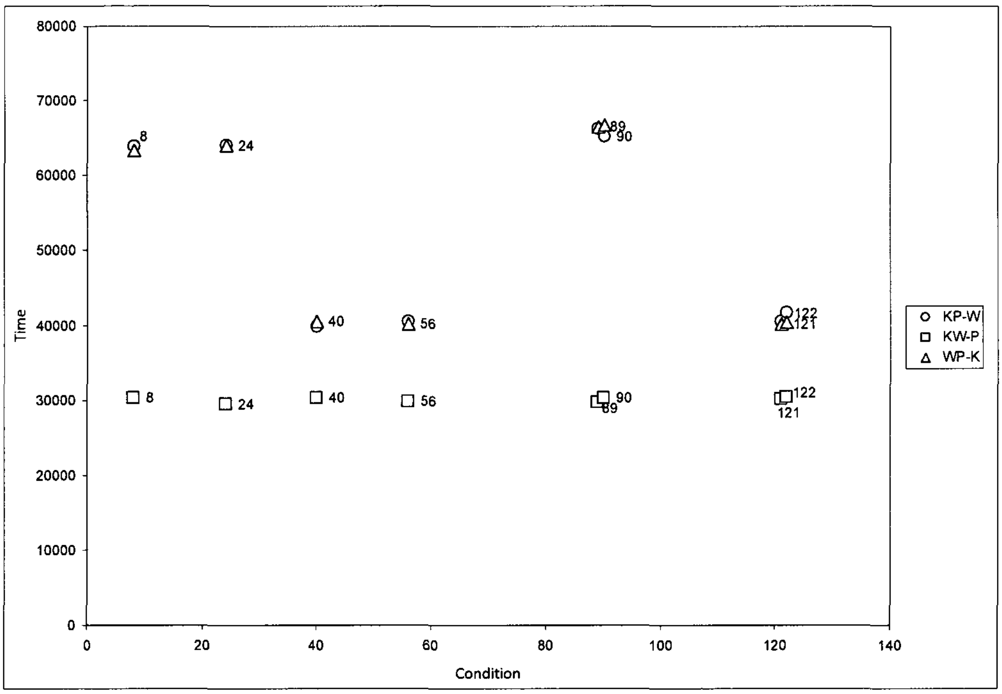

Figure 64. Comparison of Means for KP-W, KW-P, and WP-K at Level 7 (Time)

Test Statistics[a,b]

	Effort
Chi-Square	225.963
df	2
Asymp. Sig.	.000

a. Kruskal Wallis Test

b. Grouping Variable: Type

Table 45. Kruskal-Wallis Test comparing Condition 56 (Time)

Ranks

	Type	N	Mean Rank
Effort	1	250	469.50
	2	250	207.73
	3	250	449.27
	Total	750	

Table 46. Kruskal-Wallis's Rank Table comparing Condition 56 (Time)

Test Statistics[a]

	Effort
Mann-Whitney U	29595.000
Wilcoxon W	60970.000
Z	-1.025
Asymp. Sig. (2-tailed)	.306

a. Grouping Variable: Type

Table 47. Mann-Whitney Test comparing KP-W and KW-P for Condition 56 (Time)

As previously mentioned, one must evaluate what is the most desired output, depending on the input, if one is to simulate what better understanding is like.

This concludes the analysis of level 7.

WO Threshold

WO has been of great use in considering the dynamism of problem conditions: low level being more dynamic than high level given that the chance to understand it is shorter. It has been clear, in terms of time, the impact that WO has on the output. What is not clear is when WO does not play a role. Initially it was thought that this was a case of a threshold. However, it is more a case of converging towards a value. Figure 65 shows the means for WO, running from condition 15 (5 time units) and passing by condition 47 (95 time units). The means are based on 30 runs per condition, increasing WO by one time unit until WO equals 160 time units (corresponding data is in Appendix M).

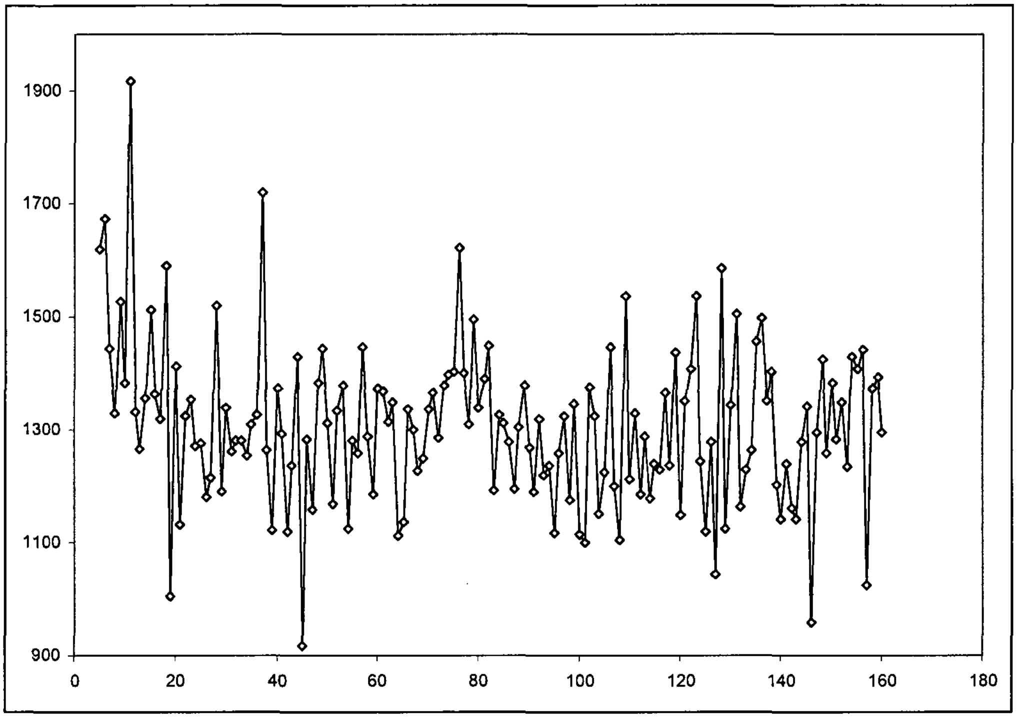

Figure 65. WO for Condition 15, from 5 to 160 Time Units

Figure 65 is not conclusive regarding the effect of WO as it grows higher. However, it can be speculated that:

- The convergence point is around 1200-1300 time units.
- There is a lot of variance between means. More runs per conditions may be needed to alleviate the effect of outliers.

A deeper analysis of WO is outside of the scope of this work, and it is considered for future work.

E. NORMALITY TEST (TIME)

Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W	Condition	WP-K	KW-P	KP-W
1	0.08	0.02	0.01	33	0.06	0.01	0	65	0.02	0.07	0.06	97	0.01	0	0.08
2	0.04	0.33	0.14	34	0.19	0.29	0.6	66	0.02	0.05	0.24	98	0.04	0.02	0
3	0.02	0.15	0.01	35	0	0.01	0	67	0.06	0	0.01	99	0.04	0.2	0
4	0.03	0	0.06	36	0.04	0.01	0.2	68	0.05	0.07	0.01	100	0.14	0.02	0.01
5	0.03	0.03	0	37	0.01	0.09	0	69	0.26	0.04	0.01	101	0.13	0.03	0.11
6	0.05	0.03	0.01	38	0.06	0.01	0.1	70	0.02	0.04	0.33	102	0.01	0.02	0
7	0	0.03	0.03	39	0.06	0	0	71	0.01	0.07	0.02	103	0.01	0	0.04
8	0.07	0	0.02	40	0.08	0	0	72	0.08	0.01	0.06	104	0.03	0.02	0.02
9	0.03	0	0.01	41	0.02	0.01	0	73	0.14	0.06	0.04	105	0	0.07	0.07
10	0.03	0.02	0.01	42	0.09	0	0	74	0.02	0	0.04	106	0.05	0.01	0
11	0	0.01	0.13	43	0.29	0.08	0	75	0.03	0	0.07	107	0	0.01	0.02
12	0	0.01	0.06	44	0.01	0	0.1	76	0.02	0	0	108	0.01	0.01	0.06
13	0.02	0.03	0.02	45	0	0.02	0.1	77	0.03	0.01	0	109	0	0.02	0.14
14	0.14	0.06	0.03	46	0.03	0.24	0.2	78	0.01	0.02	0.01	110	0.01	0.07	0.06
15	0	0	0	47	0.01	0.07	0	79	0.01	0.06	0.02	111	0.01	0.09	0.01
16	0.04	0.1	0.06	48	0.14	0.09	0	80	0.08	0	0.03	112	0.02	0.03	0.01
17	0.08	0.54	0.28	49	0.07	0.86	0	81	0.03	0.03	0.01	113	0.04	0	0.01
18	0.03	0.91	0.07	50	0.08	0.7	0.6	82	0.03	0.09	0.02	114	0.07	0.11	0.01
19	0.01	0	0.03	51	0.02	0.01	0	83	0.29	0.2	0.25	115	0.31	0.03	0.19
20	0.16	0.03	0.13	52	0.11	0.14	0	84	0.09	0.09	0.06	116	0.01	0.05	0
21	0.01	0.01	0.05	53	0.03	0	0.1	85	0.02	0.01	0.29	117	0.16	0.03	0.17
22	0.07	0.21	0.09	54	0.38	0.44	0	86	0.17	0.14	0.04	118	0.22	0.07	0.54
23	0.01	0	0.13	55	0.02	0.01	0	87	0.02	0.04	0.07	119	0.02	0.04	0.01
24	0.26	0.08	0.11	56	0.29	0.07	0	88	0	0.09	0.02	120	0.19	0.26	0
25	0.02	0.02	0.14	57	0.1	0.02	0	89	0.01	0.39	0.15	121	0.01	0.27	0.02
26	0.04	0.07	0.02	58	0.01	0.24	0	90	0.25	0.06	0.02	122	0.1	0.02	0
27	0.02	0.03	0.01	59	0.05	0	0.3	91	0.01	0.06	0.14	123	0.03	0.06	0.06
28	0.01	0.23	0.06	60	0.01	0.06	0	92	0.06	0	0.06	124	0	0.09	0.18
29	0.21	0.03	0	61	0.03	0.11	0.1	93	0.05	0.04	0.12	125	0.09	0	0.05
30	0.05	0.02	0.13	62	0.02	0.04	0	94	0.04	0.38	0.01	126	0.09	0.06	0.19
31	0.02	0.05	0.01	63	0.02	0.02	0.1	95	0.08	0.32	0	127	0.01	0.05	0.07
32	0.14	0.23	0.02	64	0.01	0.01	0	96	0	0.07	0.03	128	0.05	0.01	0.21

F. LEVENE AND F TESTS FOR CONDITIONS 1, 13, AND 99 RESPECTIVELY

Test of Homogeneity of Variances

Effort

Levene Statistic	df1	df2	Sig.
2.930	2	747	.054

ANOVA

Effort

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15.619	2	7.809	.065	.937
Within Groups	89489.336	747	119.798		
Total	89504.955	749			

Test of Homogeneity of Variances

Effort

Levene Statistic	df1	df2	Sig.
1.594	2	747	.204

ANOVA

Effort

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	45.683	2	22.841	.196	.822
Within Groups	87176.276	747	116.702		
Total	87221.959	749			

Test of Homogeneity of Variances

Effort

Levene Statistic	df1	df2	Sig.
.218	2	747	.804

ANOVA

Effort

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2361.192	2	1180.596	10.388	.000
Within Groups	84893.476	747	113.646		
Total	87254.668	749			

G. TAMHANE'S T2 TEST FOR LEVEL 2 (EFFORT)

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	3.00	5.00	-12.99200	7.70770	1.000	-41.2733	15.2893
		9.00	-13.49200	7.20454	1.000	-39.9242	12.9402
		11.00	-13.12400	6.34729	1.000	-36.4256	10.1776
		15.00	1.18400	7.27462	1.000	-25.5061	27.8741
		35.00	-13.21200	7.46442	1.000	-40.5985	14.1745
		37.00	-21.58600	7.75608	.665	-50.0473	6.8713
		41.00	-14.02800	7.55139	1.000	-41.7342	13.6782
		43.00	-9.96400	6.26518	1.000	-32.9677	13.0397
		47.00	-7.16400	7.09361	1.000	-33.1895	18.8615
		65.00	-26.24000	7.39495	.077	-53.3712	.8912
		69.00	-12.00000	6.48746	1.000	-35.8111	11.8111
		71.00	-7.29600	7.28292	1.000	-34.0159	19.4239
		75.00	-24.30000	7.50525	.217	-51.9366	3.2366
		77.00	-16.60000	7.49140	.995	-44.0857	10.8857
		97.00	-3.93200	7.21929	1.000	-30.4184	22.5544
		101.00	-17.42400	6.49545	.764	-41.2642	6.4162
		103.00	-10.09200	7.56774	1.000	-37.8564	17.6744
		107.00	-2.30000	7.30166	1.000	-29.0866	24.4866
		109.00	2.78400	7.04744	1.000	-23.0723	28.6403
	5.00	3.00	12.99200	7.70770	1.000	-15.2893	41.2733
		9.00	-.50000	7.69317	1.000	-28.7282	27.7282
		11.00	-.13200	6.89893	1.000	-25.4651	25.2011
		15.00	14.17600	7.75903	1.000	-14.2930	42.6450
		35.00	-.22000	7.93707	1.000	-29.3405	28.9005
		37.00	-8.59600	8.21195	1.000	-38.7243	21.5323
		41.00	-1.03600	8.01891	1.000	-30.4563	28.3843
		43.00	3.02800	6.82144	1.000	-22.0326	28.0886
		47.00	5.82800	7.59939	1.000	-22.0212	33.6772
		65.00	-13.24800	7.87177	1.000	-42.1294	15.6334
		69.00	.99200	7.02614	1.000	-24.8066	26.7926
		71.00	5.69600	7.78662	1.000	-22.8007	34.1927
		75.00	-11.30800	7.97549	1.000	-40.5692	17.9532
		77.00	-3.60800	7.96245	1.000	-32.8214	25.6054
		97.00	9.06000	7.70699	1.000	-19.2187	37.3387
		101.00	-4.43200	7.03351	1.000	-30.2593	21.3953
		103.00	2.90000	8.03431	1.000	-26.5768	32.3768
		107.00	10.69200	7.79420	1.000	-17.8690	39.2530
		109.00	15.77600	7.54625	.999	-11.9159	43.4678

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	9.00	3.00	13.49200	7.20454	1.000	-12.9402	39.9242
		5.00	.50000	7.69317	1.000	-27.7282	28.7282
		11.00	.36800	6.32964	1.000	-22.8685	23.6045
		15.00	14.67600	7.25943	1.000	-11.9577	41.3097
		35.00	.28000	7.44942	1.000	-27.0516	27.6116
		37.00	-8.09600	7.74163	1.000	-36.5026	20.3106
		41.00	-.53600	7.53655	1.000	-28.1860	27.1160
		43.00	3.52800	6.24730	1.000	-19.4097	26.4657
		47.00	6.32800	7.07762	1.000	-19.6395	32.2955
		65.00	-12.74800	7.37961	1.000	-39.8239	14.3278
		69.00	1.49200	6.47019	1.000	-22.2554	25.2394
		71.00	6.19600	7.26754	1.000	-20.4675	32.8595
		75.00	-10.80800	7.49033	1.000	-38.2900	16.6740
		77.00	-3.10800	7.47646	1.000	-30.5390	24.3230
		97.00	9.56000	7.20378	1.000	-16.8695	35.9895
		101.00	-3.93200	6.47820	1.000	-27.7086	19.8446
		103.00	3.40000	7.55294	1.000	-24.3122	31.1122
		107.00	11.19200	7.29632	1.000	-15.5404	37.9244
		109.00	16.27600	7.03155	.982	-9.5219	42.0739
	11.00	3.00	13.12400	6.34729	1.000	-10.1776	36.4256
		5.00	.13200	6.89893	1.000	-25.2011	25.4651
		9.00	-.36800	6.32964	1.000	-23.6045	22.8685
		15.00	14.30800	6.40953	.993	-9.2235	37.8395
		35.00	-.08800	6.62294	1.000	-24.4118	24.2358
		37.00	-8.46400	6.95094	1.000	-33.9969	17.0689
		41.00	-.90400	6.72178	1.000	-25.5895	23.7815
		43.00	3.16000	5.23560	1.000	-16.0467	22.3667
		47.00	5.96000	6.20309	1.000	-16.8092	28.7292
		65.00	-13.11600	6.54556	1.000	-37.1501	10.9181
		69.00	1.12400	5.49665	1.000	-19.0539	21.3018
		71.00	5.82800	6.41872	1.000	-17.7374	29.3934
		75.00	-11.17600	6.66991	1.000	-35.6697	13.3177
		77.00	-3.47600	6.65433	1.000	-27.9121	20.9601
		97.00	9.19200	6.34643	1.000	-14.1065	32.4905
		101.00	-4.30000	5.50607	1.000	-24.5124	15.9124
		103.00	3.03200	6.74015	1.000	-21.7214	27.7654
		107.00	10.82400	6.43997	1.000	-12.8200	34.4680
		109.00	15.90800	6.15024	.862	-6.6662	38.4822

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	15.00	3.00	-1.18400	7.27462	1.000	-27.8741	25.5061
		5.00	-14.17600	7.75903	1.000	-42.6450	14.2930
		9.00	-14.67600	7.25943	1.000	-41.3097	11.9577
		11.00	-14.30600	6.40953	.993	-37.8395	9.2235
		35.00	-14.39600	7.51742	1.000	-41.9766	13.1846
		37.00	-22.77200	7.60709	.505	-51.4178	5.8738
		41.00	-15.21200	7.60377	1.000	-43.1100	12.6660
		43.00	-11.14600	6.32823	1.000	-34.3847	12.0697
		47.00	-8.34600	7.14935	1.000	-34.5763	17.8623
		65.00	-27.42400*	7.44844	.046	-54.7513	-.0967
		69.00	-13.18400	6.54836	1.000	-37.2199	10.8519
		71.00	-8.48000	7.33723	1.000	-35.3990	18.4390
		75.00	-25.48400	7.55798	.142	-53.2138	2.2456
		77.00	-17.78400	7.54421	.973	-45.4631	9.8951
		97.00	-5.11600	7.27409	1.000	-31.8034	21.5714
		101.00	-18.60600	6.55628	.594	-42.6727	5.4567
		103.00	-11.27600	7.62002	1.000	-39.2337	16.6817
		107.00	-3.48400	7.35563	1.000	-30.4713	23.5033
		109.00	1.60000	7.10255	1.000	-24.4625	27.6625
	35.00	3.00	13.21200	7.46442	1.000	-14.1745	40.5985
		5.00	.22000	7.93707	1.000	-28.9005	29.3405
		9.00	-.28000	7.44942	1.000	-27.6116	27.0516
		11.00	.08600	6.62294	1.000	-24.2358	24.4118
		15.00	14.39600	7.51742	1.000	-13.1846	41.9766
		37.00	-8.37600	7.98405	1.000	-37.6691	20.9171
		41.00	-.81600	7.78636	1.000	-29.3793	27.7473
		43.00	3.24600	6.54631	1.000	-20.7912	27.2872
		47.00	6.04600	7.34219	1.000	-20.8912	32.9672
		65.00	-13.02600	7.63373	1.000	-41.0349	14.9789
		69.00	1.21200	6.75837	1.000	-23.5992	26.0232
		71.00	5.91600	7.52625	1.000	-21.6933	33.5253
		75.00	-11.08600	7.74062	1.000	-39.4871	17.3111
		77.00	-3.38600	7.72720	1.000	-31.7378	24.9618
		97.00	9.28000	7.46369	1.000	-18.1038	36.6638
		101.00	-4.21200	6.76604	1.000	-29.0511	20.6271
		103.00	3.12000	7.60123	1.000	-25.5015	31.7415
		107.00	10.91200	7.54339	1.000	-16.7638	38.5878
		109.00	15.99600	7.29760	.966	-10.7801	42.7721

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	37.00	3.00	21.58600	7.75606	.655	-6.8713	50.0473
		5.00	8.59600	8.21195	1.000	-21.5323	38.7243
		9.00	8.09600	7.74163	1.000	-20.3106	36.5026
		11.00	8.46400	6.95094	1.000	-17.0659	33.9959
		15.00	22.77200	7.60709	.505	-5.8738	51.4178
		35.00	8.37600	7.98405	1.000	-20.9171	37.6691
		41.00	7.56000	8.06541	1.000	-22.0311	37.1511
		43.00	11.62400	6.87604	1.000	-13.6356	36.8836
		47.00	14.42400	7.63850	1.000	-13.6061	42.4541
		65.00	-4.65200	7.91914	1.000	-33.7076	24.4036
		69.00	9.58600	7.07916	1.000	-16.4056	35.5846
		71.00	14.29200	7.81462	1.000	-14.3813	42.9653
		75.00	-2.71200	8.02223	1.000	-32.1450	26.7210
		77.00	4.98600	8.00929	1.000	-24.3975	34.3735
		97.00	17.65600	7.75536	.989	-10.8008	46.1128
		101.00	4.16400	7.08649	1.000	-21.8591	30.1871
		103.00	11.49600	8.08072	1.000	-18.1512	41.1432
		107.00	19.28600	7.83209	.933	-9.4492	48.0252
		109.00	24.37200	7.59565	.237	-3.5018	52.2458
	41.00	3.00	14.02600	7.55139	1.000	-13.6762	41.7342
		5.00	1.03600	8.01891	1.000	-28.3843	30.4563
		9.00	.52600	7.53655	1.000	-27.1160	28.1680
		11.00	.90400	6.72179	1.000	-23.7815	25.5695
		15.00	15.21200	7.60377	1.000	-12.6860	43.1100
		35.00	.81600	7.78636	1.000	-27.7473	29.3793
		37.00	-7.56000	8.06541	1.000	-37.1511	22.0311
		43.00	4.06400	6.64431	1.000	-20.3413	28.4693
		47.00	6.86400	7.43059	1.000	-20.4004	34.1284
		65.00	-12.21200	7.71878	1.000	-40.5312	16.1072
		69.00	2.02600	6.85430	1.000	-23.1376	27.1936
		71.00	6.73200	7.61152	1.000	-21.1943	34.6583
		75.00	-10.27200	7.82451	1.000	-38.9769	18.4348
		77.00	-2.57200	7.81123	1.000	-31.2301	26.0861
		97.00	10.09600	7.55068	1.000	-17.6076	37.7996
		101.00	-3.39600	6.88168	1.000	-28.5890	21.7970
		103.00	3.93600	7.68447	1.000	-24.9908	32.8628
		107.00	11.72600	7.62945	1.000	-16.2640	39.7200
		109.00	16.81200	7.39652	.989	-10.2914	43.9154

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	43.00	3.00	9.96400	6.28518	1.000	-13.0397	32.9677
		5.00	-3.02600	6.82144	1.000	-29.0868	22.0328
		9.00	-3.52600	6.24730	1.000	-28.4657	19.4097
		11.00	-3.16000	5.23560	1.000	-22.3687	16.0487
		15.00	11.14600	6.32823	1.000	-12.0867	34.3647
		35.00	-3.24600	6.54631	1.000	-27.2872	20.7912
		37.00	-11.62400	6.67604	1.000	-38.8868	13.6398
		41.00	-4.06400	6.64431	1.000	-28.4693	20.3413
		47.00	2.80000	6.11904	1.000	-19.6639	25.2639
		65.00	-16.27600	6.46597	.903	-40.0219	7.4698
		69.00	-2.03600	5.40468	1.000	-21.8662	17.7942
		71.00	2.66600	6.33753	1.000	-20.6031	25.9391
		75.00	-14.33600	6.59163	.997	-38.5472	9.8752
		77.00	-6.63600	6.57606	1.000	-30.7868	17.5168
		97.00	6.03200	6.26431	1.000	-16.9665	29.0325
		101.00	-7.46000	5.41427	1.000	-27.3255	12.4055
		103.00	-.12600	6.66259	1.000	-24.6021	24.3461
		107.00	7.66400	6.35908	1.000	-15.6867	31.0147
		109.00	12.74600	6.08547	.999	-9.5160	35.0140
	47.00	3.00	7.16400	7.09261	1.000	-18.8615	33.1695
		5.00	-5.82600	7.59938	1.000	-33.6772	22.0212
		9.00	-6.32600	7.07762	1.000	-32.2955	19.6395
		11.00	-5.96000	6.20309	1.000	-28.7292	16.8092
		15.00	8.34600	7.14935	1.000	-17.8823	34.5783
		35.00	-6.04600	7.34219	1.000	-32.9872	20.8912
		37.00	-14.42400	7.63850	1.000	-42.4541	13.6061
		41.00	-6.86400	7.43058	1.000	-34.1284	20.4004
		43.00	-2.80000	6.11904	1.000	-25.2639	19.6639
		65.00	-19.07600	7.27155	.820	-45.7554	7.6034
		69.00	-4.83600	6.34644	1.000	-28.1270	18.4550
		71.00	-.13200	7.15759	1.000	-26.3925	26.1285
		75.00	-17.13600	7.38369	.981	-44.2279	9.9559
		77.00	-9.43600	7.38962	1.000	-36.4761	17.6041
		97.00	3.23200	7.09264	1.000	-22.7907	29.2547
		101.00	-10.26000	6.35460	1.000	-33.5809	13.0608
		103.00	-2.92600	7.44720	1.000	-30.2536	24.3976
		107.00	4.86400	7.17666	1.000	-21.4666	31.1946
		109.00	9.94600	6.91765	1.000	-15.4324	35.3284

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	65.00	3.00	26.24000	7.39495	.077	-.8912	53.3712
		5.00	13.24600	7.67177	1.000	-15.6334	42.1294
		9.00	12.74600	7.37961	1.000	-14.3278	39.8238
		11.00	13.11600	6.54556	1.000	-10.9181	37.1501
		15.00	27.42400*	7.44844	.046	.0967	54.7513
		35.00	13.02600	7.63373	1.000	-14.9769	41.0349
		37.00	4.65200	7.91914	1.000	-24.4036	33.7076
		41.00	12.21200	7.71878	1.000	-16.1072	40.5312
		43.00	16.27600	6.46597	.903	-7.4698	40.0218
		47.00	19.07600	7.27155	.920	-7.6034	45.7554
		69.00	14.24000	6.69156	.998	-10.2876	38.7676
		71.00	18.94400	7.45635	.986	-8.4122	46.3002
		75.00	1.94000	7.67365	1.000	-26.2135	30.0935
		77.00	9.64000	7.68011	1.000	-18.4638	37.7438
		97.00	22.30600	7.39421	.400	-4.8205	49.4365
		101.00	8.81600	6.69932	1.000	-15.7399	33.3718
		103.00	16.14600	7.73478	.999	-12.2300	44.5260
		107.00	23.94000	7.47465	.241	-3.4834	51.3634
		109.00	29.02400*	7.22652	.013	2.5094	55.5388
	69.00	3.00	12.00000	6.48746	1.000	-11.8111	35.8111
		5.00	-.99200	7.02814	1.000	-26.7926	24.8086
		9.00	-1.49200	6.47019	1.000	-25.2394	22.2554
		11.00	-1.12400	5.49965	1.000	-21.3018	19.0538
		15.00	13.18400	6.54836	1.000	-10.8519	37.2199
		35.00	-1.21200	6.75837	1.000	-26.0232	23.5992
		37.00	-9.58600	7.07916	1.000	-35.5846	16.4086
		41.00	-2.02600	6.65430	1.000	-27.1936	23.1376
		43.00	2.03600	5.40469	1.000	-17.7942	21.8662
		47.00	4.83600	6.34644	1.000	-18.4550	28.1270
		65.00	-14.24000	6.69156	.998	-38.7676	10.2876
		71.00	4.70400	6.55738	1.000	-19.3651	28.7731
		75.00	-12.30000	6.80344	1.000	-37.2777	12.6777
		77.00	-4.60000	6.79816	1.000	-29.5213	20.3213
		97.00	8.06600	6.49662	1.000	-15.7400	31.8760
		101.00	-5.42400	5.68999	1.000	-26.2263	15.3783
		103.00	1.90600	6.67231	1.000	-23.3241	27.1401
		107.00	9.70000	6.57816	1.000	-14.4459	33.8459
		109.00	14.78400	6.29479	.975	-8.3166	37.8846

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	71.00	3.00	7.29600	7.28292	1.000	-19.4239	34.0159
		5.00	-5.69600	7.76662	1.000	-34.1927	22.8007
		9.00	-6.19600	7.26754	1.000	-32.8595	20.4675
		11.00	-5.82600	6.41872	1.000	-29.3934	17.7374
		15.00	8.48000	7.33723	1.000	-18.4290	35.3990
		35.00	-5.91600	7.52525	1.000	-33.5253	21.6933
		37.00	-14.29200	7.61462	1.000	-42.9653	14.3813
		41.00	-6.73200	7.61152	1.000	-34.6563	21.1943
		43.00	-2.66600	6.33753	1.000	-25.9391	20.6031
		47.00	.13200	7.15759	1.000	-26.1265	26.3925
		65.00	-18.94400	7.45635	.986	-46.3002	8.4122
		69.00	-4.70400	6.55738	1.000	-28.7731	19.3651
		75.00	-17.00400	7.56675	.992	-44.7621	10.7541
		77.00	-9.30400	7.55201	1.000	-37.0116	18.4036
		97.00	3.36400	7.28217	1.000	-23.3531	30.0811
		101.00	-10.12600	6.56526	1.000	-34.2259	13.9698
		103.00	-2.79600	7.62774	1.000	-30.7820	25.1900
		107.00	4.99600	7.36363	1.000	-22.0207	32.0127
		109.00	10.08000	7.11164	1.000	-16.0130	36.1730
	75.00	3.00	24.30000	7.50525	.217	-3.2366	51.8366
		5.00	11.30600	7.97648	1.000	-17.9632	40.6692
		9.00	10.80600	7.49033	1.000	-16.6740	38.2900
		11.00	11.17600	6.68991	1.000	-13.3177	35.6697
		15.00	25.48400	7.55798	.142	-2.2456	53.2136
		35.00	11.08600	7.74062	1.000	-17.3111	39.4671
		37.00	2.71200	8.02223	1.000	-26.7210	32.1450
		41.00	10.27200	7.62451	1.000	-18.4348	38.9798
		43.00	14.33600	6.59163	.997	-9.8752	38.5472
		47.00	17.13600	7.39369	.981	-9.9659	44.2279
		65.00	-1.94000	7.67365	1.000	-30.0935	26.2135
		69.00	12.30000	6.60344	1.000	-12.6777	37.2777
		71.00	17.00400	7.56675	.992	-10.7541	44.7621
		77.00	7.70000	7.76664	1.000	-20.7945	36.1945
		97.00	20.36600	7.50452	.731	-7.1659	47.9019
		101.00	6.87600	6.61105	1.000	-18.1293	31.8813
		103.00	14.20600	7.64030	1.000	-14.5569	42.9728
		107.00	22.00000	7.59379	.523	-5.8242	49.8242
		109.00	27.08400*	7.33935	.046	.1542	54.0138

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	77.00	3.00	16.60000	7.49140	.995	-10.8857	44.0857
		5.00	3.60600	7.96245	1.000	-25.6054	32.8214
		9.00	3.10600	7.47646	1.000	-24.3230	30.5390
		11.00	3.47600	6.65433	1.000	-20.9601	27.9121
		15.00	17.78400	7.54421	.973	-9.8951	45.4631
		35.00	3.38600	7.72720	1.000	-24.9618	31.7378
		37.00	-4.98600	8.00928	1.000	-34.3735	24.3975
		41.00	2.57200	7.61123	1.000	-26.0861	31.2301
		43.00	6.63600	6.57606	1.000	-17.5169	30.7889
		47.00	9.43600	7.36962	1.000	-17.6041	36.4761
		65.00	-9.64000	7.66011	1.000	-37.7438	18.4638
		69.00	4.60000	6.79816	1.000	-20.3213	29.5213
		71.00	9.30400	7.55201	1.000	-18.4036	37.0116
		75.00	-7.70000	7.76664	1.000	-36.1945	20.7945
		97.00	12.66600	7.49069	1.000	-14.8150	40.1510
		101.00	-.82400	6.79550	1.000	-25.7730	24.1250
		103.00	6.50600	7.62705	1.000	-22.2062	35.2242
		107.00	14.30000	7.57009	1.000	-13.4739	42.0739
		109.00	19.38400	7.32519	.799	-7.4937	46.2617
	97.00	3.00	3.93200	7.21929	1.000	-22.5544	30.4184
		5.00	-9.06000	7.70699	1.000	-37.3367	19.2187
		9.00	-9.56000	7.20378	1.000	-35.9895	16.8695
		11.00	-9.19200	6.34643	1.000	-32.4905	14.1065
		15.00	5.11600	7.27409	1.000	-21.5714	31.8034
		35.00	-9.28000	7.46369	1.000	-36.6639	18.1038
		37.00	-17.65600	7.75538	.989	-46.1129	10.8008
		41.00	-10.09600	7.55066	1.000	-37.7998	17.6078
		43.00	-6.03200	6.26431	1.000	-29.0325	16.9685
		47.00	-3.23200	7.09264	1.000	-29.2547	22.7907
		65.00	-22.30600	7.39421	.400	-49.4365	4.8205
		69.00	-8.06600	6.48662	1.000	-31.9760	15.7400
		71.00	-3.36400	7.28217	1.000	-30.0811	23.3531
		75.00	-20.36600	7.50452	.731	-47.9019	7.1659
		77.00	-12.66600	7.49069	1.000	-40.1510	14.8150
		101.00	-13.49200	6.49461	.989	-37.3291	10.3451
		103.00	-6.16000	7.56702	1.000	-33.9237	21.6037
		107.00	1.63200	7.30091	1.000	-25.1539	28.4179
		109.00	6.71600	7.04667	1.000	-19.1375	32.5695

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	101.00	3.00	17.42400	6.49545	.764	-6.4162	41.2642
		5.00	4.43200	7.03351	1.000	-21.3953	30.2593
		9.00	3.93200	6.47820	1.000	-19.8446	27.7086
		11.00	4.30000	5.50907	1.000	-15.9124	24.5124
		15.00	18.60500	6.55628	.594	-5.4567	42.6727
		35.00	4.21200	6.78604	1.000	-20.6271	29.0511
		37.00	-4.16400	7.09649	1.000	-30.1871	21.8591
		41.00	3.39600	6.68168	1.000	-21.7970	28.5890
		43.00	7.46000	5.41427	1.000	-12.4055	27.3255
		47.00	10.26000	6.35460	1.000	-13.0609	33.5808
		65.00	-8.81600	6.69932	1.000	-33.3718	15.7398
		69.00	5.42400	5.66999	1.000	-15.3763	26.2263
		71.00	10.12800	6.56526	1.000	-13.9698	34.2258
		75.00	-6.87600	6.81105	1.000	-31.8813	18.1293
		77.00	.82400	6.79560	1.000	-24.1250	25.7730
		97.00	13.49200	6.49461	.969	-10.3451	37.3291
		103.00	7.33200	6.67965	1.000	-17.9275	32.5915
		107.00	15.12400	6.58604	.986	-9.0505	39.2985
		109.00	20.20800	6.30303	.229	-2.9228	43.3386
	103.00	3.00	10.09200	7.56774	1.000	-17.6744	37.8594
		5.00	-2.90000	8.03431	1.000	-32.3768	26.5768
		9.00	-3.40000	7.55294	1.000	-31.1122	24.3122
		11.00	-3.03200	6.74015	1.000	-27.7854	21.7214
		15.00	11.27600	7.62002	1.000	-16.6817	39.2337
		35.00	-3.12000	7.80123	1.000	-31.7415	25.5015
		37.00	-11.49600	8.08072	1.000	-41.1432	18.1512
		41.00	-3.93600	7.69447	1.000	-32.8629	24.9908
		43.00	.12800	6.68269	1.000	-24.3461	24.6021
		47.00	2.92800	7.44720	1.000	-24.3976	30.2536
		65.00	-16.14800	7.73478	.999	-44.5260	12.2300
		69.00	-1.90800	6.87231	1.000	-27.1401	23.3241
		71.00	2.79600	7.62774	1.000	-25.1900	30.7820
		75.00	-14.20800	7.84030	1.000	-42.9729	14.5568
		77.00	-6.50800	7.62705	1.000	-35.2242	22.2082
		97.00	6.16000	7.56702	1.000	-21.6037	33.9237
		101.00	-7.33200	6.67965	1.000	-32.5915	17.9275
		107.00	7.79200	7.64564	1.000	-20.2595	35.8435
		109.00	12.87600	7.40324	1.000	-14.2890	40.0410

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	107.00	3.00	2.30000	7.30168	1.000	-24.4886	29.0686
		5.00	-10.69200	7.78420	1.000	-39.2530	17.8690
		9.00	-11.19200	7.29632	1.000	-37.9244	15.5404
		11.00	-10.82400	6.43997	1.000	-34.4660	12.8200
		15.00	3.48400	7.35583	1.000	-23.5033	30.4713
		35.00	-10.91200	7.54339	1.000	-38.5878	16.7638
		37.00	-19.28800	7.83209	.933	-48.0252	9.4492
		41.00	-11.72800	7.62945	1.000	-39.7200	16.2640
		43.00	-7.66400	6.35906	1.000	-31.0147	15.6867
		47.00	-4.86400	7.17668	1.000	-31.1946	21.4666
		65.00	-23.94000	7.47465	.241	-51.3634	3.4634
		69.00	-9.70000	6.57816	1.000	-33.8459	14.4459
		71.00	-4.99600	7.38363	1.000	-32.0127	22.0207
		75.00	-22.00000	7.59379	.523	-49.8242	5.8242
		77.00	-14.30000	7.57009	1.000	-42.0739	13.4739
		97.00	-1.63200	7.30091	1.000	-29.4179	25.1539
		101.00	-15.12400	6.58604	.986	-39.2985	9.0505
		103.00	-7.79200	7.64564	1.000	-35.8435	20.2595
		109.00	5.08400	7.13103	1.000	-21.0795	31.2475
	109.00	3.00	-2.78400	7.04744	1.000	-28.6403	23.0723
		5.00	-15.77600	7.54825	.999	-43.4678	11.9158
		9.00	-16.27600	7.03155	.982	-42.0739	9.5219
		11.00	-15.90800	6.15024	.852	-38.4822	6.6662
		15.00	-1.60000	7.10255	1.000	-27.6625	24.4625
		35.00	-15.99600	7.29760	.996	-42.7721	10.7801
		37.00	-24.37200	7.59565	.237	-52.2458	3.5018
		41.00	-16.81200	7.38652	.989	-43.9154	10.2914
		43.00	-12.74800	6.08547	.999	-35.0140	9.5180
		47.00	-9.94800	6.91765	1.000	-35.3264	15.4324
		65.00	-29.02400*	7.22652	.013	-55.5368	-2.5094
		69.00	-14.78400	6.29479	.975	-37.8846	8.3166
		71.00	-10.08000	7.11164	1.000	-36.1730	16.0130
		75.00	-27.08400*	7.33935	.046	-54.0138	-.1542
		77.00	-19.38400	7.32519	.799	-46.2617	7.4937
		97.00	-6.71600	7.04667	1.000	-32.5695	19.1375
		101.00	-20.20800	6.30303	.229	-43.3368	2.9228
		103.00	-12.87600	7.40324	1.000	-40.0410	14.2890
		107.00	-5.08400	7.13103	1.000	-31.2475	21.0795

H. TAMHANE'S T2 TEST EXCLUDING CONDITIONS 3, 15, AND 109

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	5.00	9.00	-.50000	7.69317	1.000	-28.0466	27.0466
		11.00	-.13200	6.89693	1.000	-24.8614	24.5874
		35.00	-.22000	7.93707	1.000	-28.6364	28.1964
		37.00	-8.59600	8.21195	1.000	-37.9958	20.8038
		41.00	-1.03600	8.01891	1.000	-29.7450	27.6730
		43.00	3.02800	6.82144	1.000	-21.4252	27.4812
		47.00	5.82800	7.56939	1.000	-21.3476	33.0036
		65.00	-13.24800	7.87177	1.000	-41.4310	14.9350
		69.00	.99200	7.02614	1.000	-24.1838	26.1678
		71.00	5.69600	7.76662	1.000	-22.1116	33.5036
		75.00	-11.30800	7.97548	1.000	-39.8617	17.2457
		77.00	-3.60800	7.96245	1.000	-32.1151	24.8991
		97.00	9.06000	7.70699	1.000	-18.5348	36.6548
		101.00	-4.43200	7.03351	1.000	-29.6339	20.7699
		103.00	2.90000	8.03431	1.000	-25.8640	31.6640
		107.00	10.69200	7.76420	1.000	-17.1783	38.5623
	9.00	5.00	.50000	7.69317	1.000	-27.0466	28.0466
		11.00	.36800	6.32964	1.000	-22.3060	23.0420
		35.00	.28000	7.44942	1.000	-26.3907	26.9507
		37.00	-8.09600	7.74163	1.000	-35.8158	19.6238
		41.00	-.53600	7.53655	1.000	-27.5193	26.4473
		43.00	3.52800	6.24730	1.000	-18.8543	25.9103
		47.00	6.32800	7.07782	1.000	-19.0116	31.6676
		65.00	-12.74800	7.37981	1.000	-39.1691	13.6731
		69.00	1.49200	6.47019	1.000	-21.6809	24.6649
		71.00	6.19600	7.26754	1.000	-19.8228	32.2148
		75.00	-10.80800	7.49033	1.000	-37.6254	16.0094
		77.00	-3.10800	7.47646	1.000	-29.8757	23.6597
		97.00	9.56000	7.20378	1.000	-16.2304	35.3504
		101.00	-3.93200	6.47820	1.000	-27.1333	19.2693
		103.00	3.40000	7.55294	1.000	-23.6421	30.4421
		107.00	11.19200	7.28632	1.000	-14.8941	37.2781

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	11.00	5.00	.13200	6.89693	1.000	-24.5874	24.8614
		9.00	-.36800	6.32964	1.000	-23.0420	22.3060
		35.00	-.08800	6.62394	1.000	-23.8227	23.6467
		37.00	-8.46400	6.95094	1.000	-33.3782	16.4502
		41.00	-.90400	6.72178	1.000	-24.9916	23.1836
		43.00	3.16000	5.23560	1.000	-15.5843	21.9043
		47.00	5.96000	6.20309	1.000	-16.2582	28.1782
		65.00	-13.11600	6.54566	.998	-36.5681	10.3361
		69.00	1.12400	5.49965	1.000	-18.5659	20.8139
		71.00	5.82800	6.41872	1.000	-17.1670	28.8230
		75.00	-11.17600	6.66991	1.000	-35.0765	12.7245
		77.00	-3.47600	6.65433	1.000	-27.3203	20.3683
		97.00	9.19200	6.34643	1.000	-13.5425	31.9265
		101.00	-4.30000	5.50907	1.000	-24.0237	15.4237
		103.00	3.03200	6.74015	1.000	-21.1218	27.1858
		107.00	10.82400	6.43997	1.000	-12.2478	33.8958
	35.00	5.00	.22000	7.93707	1.000	-28.1964	28.6364
		9.00	-.28000	7.44942	1.000	-26.9507	26.3907
		11.00	.08800	6.62394	1.000	-23.6467	23.8227
		37.00	-8.37600	7.98405	1.000	-36.9608	20.2088
		41.00	-.81600	7.78526	1.000	-28.6887	27.0567
		43.00	3.24800	6.54631	1.000	-20.2089	26.7049
		47.00	6.04800	7.34219	1.000	-20.2398	32.3358
		65.00	-13.02800	7.63373	1.000	-40.3577	14.3017
		69.00	1.21200	6.75837	1.000	-22.9987	25.4227
		71.00	5.91600	7.52526	1.000	-21.0257	32.8577
		75.00	-11.08800	7.74062	1.000	-38.8004	16.6244
		77.00	-3.38800	7.72720	1.000	-31.0523	24.2763
		97.00	9.28000	7.46369	1.000	-17.4417	36.0017
		101.00	-4.21200	6.76604	1.000	-28.4498	20.0258
		103.00	3.12000	7.80123	1.000	-24.8095	31.0495
		107.00	10.91200	7.54339	1.000	-16.0946	37.9186

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	37.00	5.00	8.59600	8.21195	1.000	-20.8038	37.9958
		9.00	8.09600	7.74163	1.000	-19.6236	35.8156
		11.00	8.46400	6.95094	1.000	-16.4502	33.3782
		35.00	8.37600	7.98405	1.000	-20.2088	36.9608
		41.00	7.56000	8.06541	1.000	-21.3156	36.4356
		43.00	11.62400	6.87604	1.000	-13.0263	36.2743
		47.00	14.42400	7.63850	1.000	-12.9281	41.7761
		65.00	-4.65200	7.91914	1.000	-33.0050	23.7010
		69.00	9.58800	7.07916	1.000	-15.7790	34.9550
		71.00	14.29200	7.81462	1.000	-13.6878	42.2718
		75.00	-2.71200	8.02223	1.000	-31.4333	26.0093
		77.00	4.98800	8.00928	1.000	-23.6870	33.6630
		97.00	17.65600	7.75536	.959	-10.1126	45.4246
		101.00	4.16400	7.08649	1.000	-21.2289	29.5569
		103.00	11.49600	8.06072	1.000	-17.4344	40.4264
		107.00	19.28800	7.83209	.856	-8.7543	47.3303
	41.00	5.00	1.03600	8.01891	1.000	-27.6730	29.7450
		9.00	.53600	7.53655	1.000	-26.4473	27.5193
		11.00	.90400	6.72178	1.000	-23.1836	24.9916
		35.00	.81600	7.76536	1.000	-27.0567	28.6887
		37.00	-7.56000	8.06541	1.000	-36.4356	21.3156
		43.00	4.06400	6.64431	1.000	-19.7500	27.8780
		47.00	6.86400	7.43058	1.000	-19.7411	33.4691
		65.00	-12.21200	7.71878	1.000	-39.8465	15.4225
		69.00	2.02800	6.85430	1.000	-22.5283	26.5843
		71.00	6.73200	7.61152	1.000	-20.5191	33.9831
		75.00	-10.27200	7.82451	1.000	-38.2848	17.7408
		77.00	-2.57200	7.81123	1.000	-30.5372	25.3932
		97.00	10.09600	7.55066	1.000	-16.9377	37.1297
		101.00	-3.39600	6.86186	1.000	-27.9791	21.1871
		103.00	3.93600	7.88447	1.000	-24.2914	32.1634
		107.00	11.72800	7.62945	1.000	-15.5871	39.0431

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	43.00	5.00	-3.02800	6.92144	1.000	-27.4812	21.4252
		9.00	-3.52800	6.24730	1.000	-25.9103	18.8543
		11.00	-3.16000	5.23560	1.000	-21.9043	15.5843
		35.00	-3.24800	6.54531	1.000	-26.7049	20.2089
		37.00	-11.62400	6.87604	1.000	-36.2743	13.0263
		41.00	-4.06400	6.64431	1.000	-27.8780	19.7500
		47.00	2.80000	6.11904	1.000	-19.1201	24.7201
		65.00	-16.27600	6.46597	.611	-39.4467	6.8947
		69.00	-2.03600	5.40468	1.000	-21.3867	17.3147
		71.00	2.66800	6.33753	1.000	-20.0396	25.3756
		75.00	-14.33600	6.59183	.985	-37.9607	9.2887
		77.00	-6.63600	6.57606	1.000	-30.2038	16.9318
		97.00	6.03200	6.26431	1.000	-16.4116	28.4756
		101.00	-7.46000	5.41427	1.000	-26.8451	11.9251
		103.00	-.12800	6.66289	1.000	-24.0091	23.7531
		107.00	7.66400	6.35906	1.000	-15.1212	30.4492
	47.00	5.00	-5.82800	7.56939	1.000	-33.0036	21.3476
		9.00	-6.32800	7.07782	1.000	-31.6676	19.0116
		11.00	-5.96000	6.20309	1.000	-28.1782	16.2582
		35.00	-6.04800	7.34219	1.000	-32.3358	20.2398
		37.00	-14.42400	7.63850	1.000	-41.7761	12.9281
		41.00	-6.86400	7.43058	1.000	-33.4691	19.7411
		43.00	-2.80000	6.11904	1.000	-24.7201	19.1201
		65.00	-19.07600	7.27155	.707	-45.1103	6.9583
		69.00	-4.83600	6.34644	1.000	-27.5636	17.8916
		71.00	-.13200	7.15759	1.000	-25.7576	25.4936
		75.00	-17.13600	7.36369	.942	-43.5727	9.3007
		77.00	-9.43600	7.36962	1.000	-35.8222	16.9502
		97.00	3.23200	7.09284	1.000	-22.1615	28.6255
		101.00	-10.26000	6.35460	1.000	-33.0166	12.4966
		103.00	-2.92800	7.44720	1.000	-29.5928	23.7368
		107.00	4.86400	7.17666	1.000	-20.8289	30.5579

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	65.00	5.00	13.24800	7.87177	1.000	-14.9350	41.4310
		9.00	12.74800	7.37981	1.000	-13.6731	39.1691
		11.00	13.11600	6.54556	.998	-10.3361	36.5681
		35.00	13.02800	7.63373	1.000	-14.3017	40.3577
		37.00	4.65200	7.91914	1.000	-23.7010	33.0050
		41.00	12.21200	7.71878	1.000	-15.4225	39.8465
		43.00	16.27600	6.46597	.811	-6.8947	39.4467
		47.00	19.07600	7.27155	.707	-6.9583	45.1103
		69.00	14.24000	6.66156	.990	-9.6940	38.1740
		71.00	18.94400	7.45635	.789	-7.7508	45.6388
		75.00	1.94000	7.67365	1.000	-25.5328	29.4128
		77.00	9.64000	7.66011	1.000	-17.7843	37.0643
		97.00	22.30800	7.39421	.306	-4.1646	48.7806
		101.00	8.81600	6.66932	1.000	-15.1455	32.7775
		103.00	16.14800	7.73478	.994	-11.5438	43.8398
		107.00	23.94000	7.47465	.179	-2.8203	50.7003
	69.00	5.00	-.99200	7.02614	1.000	-26.1678	24.1838
		9.00	-1.49200	6.47019	1.000	-24.6649	21.6809
		11.00	-1.12400	5.49965	1.000	-20.8139	18.5659
		35.00	-1.21200	6.75837	1.000	-25.4227	22.9987
		37.00	-9.58800	7.07916	1.000	-34.9550	15.7790
		41.00	-2.02800	6.85430	1.000	-26.5843	22.5283
		43.00	2.03600	5.40468	1.000	-17.3147	21.3867
		47.00	4.83600	6.34644	1.000	-17.8916	27.5636
		65.00	-14.24000	6.66156	.990	-38.1740	9.6940
		71.00	4.70400	6.55736	1.000	-18.7826	28.1906
		75.00	-12.30000	6.80344	1.000	-36.6730	12.0730
		77.00	-4.60000	6.78816	1.000	-28.9180	19.7180
		97.00	8.06800	6.46662	1.000	-15.1640	31.3000
		101.00	-5.42400	5.66999	1.000	-25.7233	14.8753
		103.00	1.90800	6.97231	1.000	-22.7133	26.5293
		107.00	9.70000	6.57816	1.000	-13.8616	33.2616

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	71.00	5.00	-5.69600	7.76662	1.000	-33.5036	22.1116
		9.00	-6.19600	7.26754	1.000	-32.2148	19.8228
		11.00	-5.82800	6.41872	1.000	-28.8230	17.1670
		35.00	-5.91600	7.52525	1.000	-32.8577	21.0257
		37.00	-14.29200	7.81462	1.000	-42.2719	13.6879
		41.00	-6.73200	7.61152	1.000	-33.9831	20.5191
		43.00	-2.66800	6.33753	1.000	-25.3756	20.0396
		47.00	.13200	7.15759	1.000	-25.4936	25.7576
		65.00	-18.94400	7.45635	.789	-45.6388	7.7508
		69.00	-4.70400	6.55736	1.000	-28.1906	18.7826
		75.00	-17.00400	7.56575	.968	-44.0909	10.0829
		77.00	-9.30400	7.55201	1.000	-36.3417	17.7337
		97.00	3.36400	7.26217	1.000	-22.7071	29.4351
		101.00	-10.12800	6.56526	1.000	-33.6427	13.3867
		103.00	-2.79600	7.62774	1.000	-30.1053	24.5133
		107.00	4.99600	7.36383	1.000	-21.3674	31.3594
	75.00	5.00	11.30800	7.97548	1.000	-17.2457	39.8617
		9.00	10.80800	7.49033	1.000	-16.0094	37.6254
		11.00	11.17600	6.66991	1.000	-12.7245	35.0765
		35.00	11.08800	7.74062	1.000	-16.6244	38.8004
		37.00	2.71200	8.02223	1.000	-26.0093	31.4333
		41.00	10.27200	7.82451	1.000	-17.7408	38.2848
		43.00	14.33600	6.59183	.985	-9.2887	37.9607
		47.00	17.13600	7.36369	.942	-9.3007	43.5727
		65.00	-1.94000	7.67365	1.000	-29.4128	25.5328
		69.00	12.30000	6.80344	1.000	-12.0730	36.6730
		71.00	17.00400	7.56575	.968	-10.0829	44.0909
		77.00	7.70000	7.76664	1.000	-20.1055	35.5055
		97.00	20.36800	7.50452	.608	-6.5001	47.2361
		101.00	6.87600	6.81105	1.000	-17.5240	31.2760
		103.00	14.20800	7.84030	1.000	-13.8613	42.2773
		107.00	22.00000	7.56379	.411	-5.1514	49.1514

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	77.00	5.00	3.60800	7.96245	1.000	-24.8991	32.1151
		9.00	3.10800	7.47646	1.000	-23.6597	29.8757
		11.00	3.47600	6.65433	1.000	-20.3683	27.3203
		35.00	3.38800	7.72720	1.000	-24.2763	31.0523
		37.00	-4.98800	8.00928	1.000	-33.6630	23.6870
		41.00	2.57200	7.81123	1.000	-25.3932	30.5372
		43.00	6.63600	6.57608	1.000	-16.9318	30.2038
		47.00	9.43600	7.38962	1.000	-16.9502	35.8222
		65.00	-9.64000	7.66011	1.000	-37.0643	17.7843
		69.00	4.60000	6.76816	1.000	-19.7180	28.9180
		71.00	9.30400	7.55201	1.000	-17.7337	36.3417
		75.00	-7.70000	7.76664	1.000	-35.5055	20.1055
		97.00	12.66800	7.49068	1.000	-14.1505	39.4865
		101.00	-.82400	6.79580	1.000	-25.1690	23.5210
		103.00	6.50800	7.82705	1.000	-21.5139	34.5299
		107.00	14.30000	7.57009	1.000	-12.8023	41.4023
	97.00	5.00	-9.06000	7.70699	1.000	-36.6548	18.5348
		9.00	-9.56000	7.20378	1.000	-35.3504	16.2304
		11.00	-9.19200	6.34643	1.000	-31.9265	13.5425
		35.00	-9.28000	7.46369	1.000	-36.0017	17.4417
		37.00	-17.65600	7.75538	.959	-45.4246	10.1126
		41.00	-10.09600	7.55066	1.000	-37.1297	16.9377
		43.00	-6.03200	6.26431	1.000	-28.4756	16.4116
		47.00	-3.23200	7.09284	1.000	-28.6255	22.1615
		65.00	-22.30800	7.39421	.306	-48.7808	4.1648
		69.00	-8.06800	6.46662	1.000	-31.3000	15.1640
		71.00	-3.36400	7.26217	1.000	-29.4351	22.7071
		75.00	-20.36800	7.50462	.609	-47.2361	6.5001
		77.00	-12.66800	7.49068	1.000	-39.4865	14.1505
		101.00	-13.49200	6.49461	.995	-36.7524	9.7684
		103.00	-6.16000	7.56702	1.000	-33.2524	20.9324
		107.00	1.63200	7.30091	1.000	-24.5063	27.7703

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	101.00	5.00	4.43200	7.03351	1.000	-20.7699	29.6339
		9.00	3.93200	6.47820	1.000	-19.2693	27.1333
		11.00	4.30000	5.50907	1.000	-15.4237	24.0237
		35.00	4.21200	6.76604	1.000	-20.0258	28.4498
		37.00	-4.16400	7.06649	1.000	-29.5569	21.2289
		41.00	3.39600	6.96186	1.000	-21.1871	27.9791
		43.00	7.46000	5.41427	1.000	-11.9251	26.8451
		47.00	10.26000	6.35460	1.000	-12.4966	33.0166
		65.00	-8.81600	6.68932	1.000	-32.7775	15.1455
		69.00	5.42400	5.66999	1.000	-14.8753	25.7233
		71.00	10.12800	6.56526	1.000	-13.3867	33.6427
		75.00	-6.87600	6.81105	1.000	-31.2760	17.5240
		77.00	.82400	6.79580	1.000	-23.5210	25.1690
		97.00	13.49200	6.49461	.995	-9.7684	36.7524
		103.00	7.33200	6.87985	1.000	-17.3160	31.9800
		107.00	15.12400	6.56604	.952	-8.4655	39.7135
	103.00	5.00	-2.90000	8.03431	1.000	-31.6640	25.8640
		9.00	-3.40000	7.55294	1.000	-30.4421	23.6421
		11.00	-3.03200	6.74015	1.000	-27.1858	21.1218
		35.00	-3.12000	7.80123	1.000	-31.0495	24.8095
		37.00	-11.49600	8.06072	1.000	-40.4264	17.4344
		41.00	-3.93600	7.86447	1.000	-32.1634	24.2914
		43.00	.12800	6.66289	1.000	-23.7531	24.0091
		47.00	2.92800	7.44720	1.000	-23.7368	29.5928
		65.00	-16.14800	7.73478	.994	-43.8398	11.5438
		69.00	-1.90800	6.87231	1.000	-26.5293	22.7133
		71.00	2.79600	7.62774	1.000	-24.5133	30.1053
		75.00	-14.20800	7.94030	1.000	-42.2773	13.8613
		77.00	-6.50800	7.82705	1.000	-34.5299	21.5139
		97.00	6.16000	7.56702	1.000	-20.9324	33.2524
		101.00	-7.33200	6.87985	1.000	-31.9800	17.3160
		107.00	7.79200	7.64564	1.000	-19.5812	35.1652
	107.00	5.00	-10.69200	7.76420	1.000	-38.5623	17.1783
		9.00	-11.19200	7.26632	1.000	-37.2781	14.8941
		11.00	-10.62400	6.43997	1.000	-33.6958	12.2476
		35.00	-10.91200	7.54339	1.000	-37.9186	16.0946
		37.00	-19.26800	7.83209	.656	-47.3303	8.7543
		41.00	-11.72800	7.62945	1.000	-39.0431	15.5871
		43.00	-7.66400	6.35906	1.000	-30.4492	15.1212
		47.00	-4.86400	7.17666	1.000	-30.5579	20.8299
		65.00	-23.94000	7.47465	.179	-50.7003	2.8203
		69.00	-9.70000	6.57816	1.000	-33.2616	13.8616
		71.00	-4.99600	7.36383	1.000	-31.3594	21.3674
		75.00	-22.00000	7.58379	.411	-49.1514	5.1514
		77.00	-14.30000	7.57009	1.000	-41.4023	12.8023
		97.00	-1.63200	7.30091	1.000	-27.7703	24.5063
		101.00	-15.12400	6.56604	.952	-38.7135	8.4655
		103.00	-7.79200	7.64564	1.000	-35.1652	19.5812

I. TAMHANE'S T2 TEST FOR LEVEL 3 (EFFORT)

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	2.00	10.00	10.43600	5.37104	1.000	-10.6782	31.5502
		14.00	15.05200*	2.74280	.000	4.3166	25.7574
		17.00	-4.00600	3.03440	1.000	-15.8672	7.8712
		19.00	27.18600*	5.04814	.000	7.3513	47.0247
		21.00	8.30600	5.80511	1.000	-14.5224	31.1394
		29.00	16.51600*	2.91389	.000	5.1103	27.9217
		31.00	30.72600*	5.41202	.000	9.4516	52.0044
		34.00	-2.74000	2.96053	1.000	-14.3289	8.8489
		42.00	-1.41200	5.72009	1.000	-23.9071	21.0631
		46.00	15.99200*	2.82646	.000	4.9213	27.0627
		49.00	-6.84000	2.86931	1.000	-18.0709	4.3909
		51.00	12.32000	5.82216	1.000	-9.7676	34.4276
		53.00	7.50400	6.17646	1.000	-16.8041	31.8121
		61.00	11.93600*	2.89105	.021	.6199	23.2521
		63.00	24.39600*	5.52413	.007	2.6762	46.1158
		66.00	11.22800	5.75099	1.000	-11.3893	33.8453
		68.00	11.95600*	2.73234	.007	1.2615	22.6505
		76.00	11.19200	5.47330	1.000	-10.3268	32.7108
		78.00	25.65200*	5.06606	.000	5.7365	45.5675
		80.00	24.39800*	2.86798	.000	13.1624	35.6136
		83.00	-5.10600	3.01633	1.000	-16.9161	6.7001
		87.00	19.37600	5.49362	.208	-2.1636	40.9356
		95.00	18.77600*	2.76903	.000	7.9380	29.6140
		96.00	6.34600	5.52597	1.000	-15.3792	28.0752
		100.00	-.94600	2.83491	1.000	-12.0440	10.1480
		108.00	8.75200	5.49628	1.000	-12.8656	30.3696
		110.00	28.57200*	5.06420	.000	8.6718	48.4722
		112.00	17.56400*	2.74906	.000	6.8041	28.3239
		115.00	-.64400	2.89339	1.000	-11.9693	10.6813
		119.00	14.54400	5.69256	.996	-7.8026	36.8906
		127.00	19.80000*	2.84356	.000	8.6702	30.9298

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	10.00	2.00	-10.43600	5.37104	1.000	-31.5502	10.6782
		14.00	4.61600	5.35291	1.000	-16.4299	25.6619
		17.00	-14.44400	5.50602	.989	-36.0760	7.1880
		19.00	16.75200	6.82748	.999	-9.9719	43.4759
		21.00	-2.12600	7.40473	1.000	-31.1120	26.8560
		29.00	6.08000	5.44256	1.000	-15.3042	27.4642
		31.00	20.29200	7.10076	.690	-7.5004	48.0844
		34.00	-13.17600	5.46768	1.000	-34.6552	8.3032
		42.00	-11.84600	7.33827	1.000	-40.5712	16.8752
		46.00	5.55600	5.39731	1.000	-15.6573	26.7693
		49.00	-17.27600	5.41683	.541	-38.5705	4.0185
		51.00	1.88400	7.26218	1.000	-26.5409	30.3089
		53.00	-2.93200	7.70092	1.000	-33.0796	27.2156
		61.00	1.50000	5.43037	1.000	-19.8381	22.8381
		63.00	13.96000	7.19657	1.000	-14.1685	42.0885
		66.00	.79200	7.36238	1.000	-28.0258	29.6098
		68.00	1.52000	5.34756	1.000	-19.5058	22.5458
		76.00	.75600	7.14757	1.000	-27.2197	28.7317
		78.00	15.21600	6.84222	1.000	-11.5655	41.9975
		80.00	13.95200	5.41613	.995	-7.3399	35.2439
		83.00	-15.54400	5.49609	.915	-37.1384	6.0504
		87.00	8.94000	7.15548	1.000	-19.0667	36.9467
		95.00	8.34000	5.36640	1.000	-12.7567	29.4367
		96.00	-4.09600	7.19799	1.000	-32.2221	24.0461
		100.00	-11.38400	5.40069	1.000	-32.6100	9.8420
		108.00	-1.68400	7.16672	1.000	-29.7347	26.3667
		110.00	18.13600	6.83936	.984	-8.6343	44.9063
		112.00	7.12600	5.35613	1.000	-13.9300	28.1680
		115.00	-11.08000	5.43162	1.000	-32.4228	10.2628
		119.00	4.10600	7.30904	1.000	-24.5006	32.7166
		127.00	9.36400	5.40523	1.000	-11.8792	30.6072

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	14.00	2.00	-15.05200*	2.74280	.000	-25.7874	-4.3166
		10.00	-4.61600	5.35291	1.000	-25.6619	16.4299
		17.00	-19.06000*	3.00220	.000	-30.8140	-7.3060
		19.00	12.13600	5.02585	1.000	-7.6278	31.8998
		21.00	-6.74400	5.79635	1.000	-29.5124	16.0244
		29.00	1.46400	2.89035	1.000	-9.8109	12.7389
		31.00	15.67600	5.39404	.657	-5.5326	36.8846
		34.00	-17.79200*	2.92752	.000	-29.2523	-6.3317
		42.00	-16.46400	5.70308	.674	-38.8951	5.9671
		46.00	.94000	2.79389	1.000	-9.9956	11.8756
		49.00	-21.89200*	2.83524	.000	-32.9899	-10.7941
		51.00	-2.73200	5.60484	1.000	-24.7745	19.3105
		53.00	-7.54600	6.16271	1.000	-31.7971	16.7011
		61.00	-3.11600	2.85724	1.000	-14.3002	8.0682
		63.00	9.34400	5.50651	1.000	-12.3095	30.9975
		66.00	-3.82400	5.73407	1.000	-26.3777	18.7297
		68.00	-3.09600	2.69654	1.000	-13.6503	7.4583
		76.00	-3.86000	5.45552	1.000	-25.3118	17.5918
		78.00	10.60000	5.04585	1.000	-9.2430	30.4430
		80.00	9.33600	2.83390	.408	-1.7566	20.4286
		83.00	-20.16000*	2.99394	.000	-31.8421	-8.4779
		87.00	4.32400	5.46587	1.000	-17.1688	25.8168
		95.00	3.72400	2.73371	1.000	-6.9758	14.4238
		96.00	-8.70400	5.50636	1.000	-30.3649	12.9569
		100.00	-16.00000*	2.80042	.000	-26.9613	-5.0387
		108.00	-6.30000	5.48058	1.000	-27.8510	15.2510
		110.00	13.52000	5.04497	.979	-6.3076	33.3476
		112.00	2.51200	2.71348	1.000	-8.1086	13.1326
		116.00	-15.69600*	2.85961	.000	-26.8895	-4.5025
		119.00	-.50800	5.66542	1.000	-22.7902	21.7742
		127.00	4.74600	2.80916	1.000	-6.2475	15.7435

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	17.00	2.00	4.00600	3.03440	1.000	-7.8712	15.8672
		10.00	14.44400	5.50602	.989	-7.1880	36.0760
		14.00	19.06000*	3.00220	.000	7.3060	30.8140
		19.00	31.19600*	5.19364	.000	10.8078	51.5842
		21.00	12.31600	5.93208	1.000	-10.9938	35.6258
		29.00	20.52400*	3.15928	.000	8.1581	32.8899
		31.00	34.73600*	5.54600	.000	12.9458	56.5262
		34.00	1.26800	3.20235	1.000	-11.2662	13.8022
		42.00	2.59600	5.84691	1.000	-20.3848	25.5768
		46.00	20.00000*	3.09066	.000	7.9407	32.0593
		49.00	-2.83200	3.11621	1.000	-15.0377	9.3737
		51.00	16.32800	5.75316	.908	-6.2739	38.9299
		53.00	11.51200	6.29791	1.000	-13.2452	36.2692
		61.00	15.94400*	3.13623	.000	3.6602	28.2278
		63.00	28.40400*	5.65741	.000	6.1809	50.6271
		66.00	15.23600	5.87913	.993	-7.8644	38.3364
		68.00	15.96400*	2.99265	.000	4.2471	27.6809
		76.00	15.20000	5.60779	.970	-6.8268	37.2268
		78.00	29.66000*	5.21302	.000	9.1952	50.1248
		80.00	28.39600*	3.11699	.000	16.1951	40.5969
		83.00	-1.10000	3.25400	1.000	-13.9362	11.6362
		87.00	23.38400*	5.61787	.020	1.3174	45.4506
		95.00	22.78400*	3.02619	.000	10.9368	34.6312
		96.00	10.35600	5.65921	1.000	-11.8742	32.5862
		100.00	3.06000	3.09659	1.000	-9.0224	15.1424
		108.00	12.76000	5.63217	1.000	-9.3632	34.8832
		110.00	32.58000*	5.20926	.000	12.1300	53.0300
		112.00	21.57200*	3.00793	.000	9.7958	33.3482
		116.00	3.38400	3.14038	1.000	-8.9282	15.6962
		119.00	18.55200	5.81220	.536	-4.2535	41.3575
		127.00	23.80600*	3.09452	.000	11.6947	35.9213

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	19.00	2.00	-27.18600*	5.04814	.000	-47.0247	-7.3513
		10.00	-16.75200	6.82748	.999	-43.4759	9.9719
		14.00	-12.13600	5.02885	1.000	-31.8998	7.6278
		17.00	-31.19600*	5.19364	.000	-51.5642	-10.8078
		21.00	-18.88000	7.17398	.987	-46.9647	9.2047
		29.00	-10.67200	5.12417	1.000	-30.7964	9.4524
		31.00	3.54000	6.85976	1.000	-23.3108	30.3906
		34.00	-29.92600*	5.15084	.000	-50.1536	-9.7024
		42.00	-28.60000*	7.10524	.032	-56.4150	-.7650
		46.00	-11.19600	5.07608	1.000	-31.1383	8.7463
		49.00	-34.02600*	5.09695	.000	-54.0569	-13.9991
		51.00	-14.86800	7.02673	1.000	-42.3741	12.6381
		53.00	-19.68400	7.47929	.987	-48.9702	9.6022
		61.00	-15.25200	5.11122	.780	-35.3274	4.8234
		63.00	-2.79200	6.94855	1.000	-29.9911	24.4071
		66.00	-15.96000	7.13024	1.000	-43.8728	11.9528
		68.00	-15.23200	5.02316	.728	-34.9744	4.5104
		76.00	-15.99600	6.90621	1.000	-43.0367	11.0447
		78.00	-1.53600	6.59179	1.000	-27.3363	24.2643
		80.00	-2.80000	5.09621	1.000	-22.8261	17.2261
		83.00	-32.29600*	5.18311	.000	-52.6442	-11.9478
		87.00	-7.81200	6.91639	1.000	-34.8848	19.2608
		95.00	-8.41200	5.04320	1.000	-28.2301	11.4061
		96.00	-20.84000	6.95002	.757	-48.0448	6.3648
		100.00	-28.13600*	5.07968	.000	-48.0919	-8.1801
		108.00	-18.43600	6.92602	.982	-45.5545	8.6825
		110.00	1.38400	6.59582	1.000	-24.4047	27.1727
		112.00	-9.82400	5.03227	1.000	-29.4008	10.1528
		115.00	-27.83200*	5.11254	.000	-47.9124	-7.7516
		119.00	-12.64400	7.07515	1.000	-40.3403	15.0523
		127.00	-7.39800	5.09450	1.000	-27.3622	12.5662

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	21.00	2.00	-8.30600	5.80511	1.000	-31.1394	14.5234
		10.00	2.12800	7.40473	1.000	-26.8560	31.1120
		14.00	6.74400	5.79535	1.000	-16.0244	29.5124
		17.00	-12.31600	5.93208	1.000	-35.6258	10.9938
		19.00	18.88000	7.17396	.987	-9.2047	46.9647
		29.00	8.20800	5.87135	1.000	-14.8727	31.2887
		31.00	22.42000	7.43452	.738	-6.6802	51.5202
		34.00	-11.04800	5.89464	1.000	-34.2165	12.1205
		42.00	-9.72000	7.66169	1.000	-39.7080	20.2680
		46.00	7.69400	5.82943	1.000	-15.2388	30.6068
		49.00	-15.14800	5.84936	.993	-38.1458	7.8498
		51.00	4.01200	7.59885	1.000	-25.6911	33.7151
		53.00	-.80400	8.00971	1.000	-32.1553	30.5473
		61.00	3.62600	5.86005	1.000	-19.4101	26.6661
		63.00	16.08800	7.51652	1.000	-13.3324	45.5084
		66.00	2.92000	7.69479	1.000	-27.1583	32.9983
		68.00	3.64800	5.78340	1.000	-19.1018	26.3978
		76.00	2.88400	7.47924	1.000	-26.3909	32.1589
		78.00	17.34400	7.19800	1.000	-10.7954	45.4834
		80.00	16.08000	5.84871	.957	-6.9154	39.0754
		83.00	-13.41600	5.92286	1.000	-36.6910	9.8590
		87.00	11.06800	7.48680	1.000	-18.2364	40.3724
		95.00	10.46800	5.80082	1.000	-12.3473	33.2833
		96.00	-1.96000	7.51787	1.000	-31.3657	27.4657
		100.00	-9.25600	5.83266	1.000	-32.1906	13.6786
		108.00	.44400	7.49764	1.000	-28.9023	29.7903
		110.00	20.26400	7.19527	.917	-7.8648	48.3928
		112.00	9.25600	5.79132	1.000	-13.5236	32.0356
		115.00	-8.95200	5.86121	1.000	-31.9944	14.0904
		119.00	6.23600	7.63370	1.000	-23.6425	36.1145
		127.00	11.49200	5.83676	1.000	-11.4584	34.4424

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	29.00	2.00	-16.51600*	2.91389	.000	-27.9217	-5.1103
		10.00	-6.08000	5.44256	1.000	-27.4642	15.3042
		14.00	-1.46400	2.89035	1.000	-12.7389	9.8109
		17.00	-20.52400*	3.15928	.000	-32.8699	-8.1581
		19.00	10.67200	5.12417	1.000	-9.4524	30.7964
		21.00	-8.20600	5.87135	1.000	-31.2887	14.8727
		31.00	14.21200	5.48301	.993	-7.3322	35.7562
		34.00	-19.25600*	3.09640	.000	-31.3441	-7.1679
		42.00	-17.92600	5.79730	.651	-40.6762	4.8202
		46.00	-.52400	2.98203	1.000	-12.1177	11.0697
		49.00	-23.35600*	3.00107	.000	-35.1023	-11.6097
		51.00	-4.19600	5.69052	1.000	-26.5612	18.1692
		53.00	-9.01200	6.24074	1.000	-33.5540	15.5300
		61.00	-4.58000	3.02186	1.000	-16.4076	7.2476
		63.00	7.88000	5.59369	1.000	-14.1022	29.8622
		66.00	-5.28600	5.81785	1.000	-28.1570	17.5810
		68.00	-4.56000	2.87039	1.000	-15.7961	6.6761
		76.00	-5.32400	5.54351	1.000	-27.1076	16.4596
		78.00	9.13600	5.14380	1.000	-11.0661	29.3381
		80.00	7.87200	2.99980	.988	-3.8693	19.6133
		83.00	-21.62400*	3.14193	.000	-33.9219	-9.3261
		87.00	2.86000	5.55370	1.000	-18.9639	24.6839
		95.00	2.26000	2.90534	1.000	-9.1124	13.6324
		98.00	-10.16800	5.59562	1.000	-32.1574	11.8214
		100.00	-17.46400*	2.96820	.000	-29.0818	-5.8462
		108.00	-7.76400	5.56617	1.000	-29.6452	14.1172
		110.00	12.05600	5.14000	1.000	-8.1311	32.2431
		112.00	1.04800	2.88631	1.000	-10.2502	12.3462
		115.00	-17.16000*	3.02410	.000	-28.9964	-5.3236
		119.00	-1.97200	5.75020	1.000	-24.5734	20.6294
		127.00	3.28400	2.97644	1.000	-8.3660	14.9340

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	31.00	2.00	-30.72600*	5.41202	.000	-52.0044	-9.4516
		10.00	-20.29200	7.10076	.690	-48.0844	7.5004
		14.00	-15.67600	5.39404	.657	-36.8846	5.5326
		17.00	-34.73600*	5.54600	.000	-56.5262	-12.9458
		19.00	-3.54000	6.85976	1.000	-30.3906	23.3106
		21.00	-22.42000	7.43452	.738	-51.5202	6.6802
		29.00	-14.21200	5.48301	.993	-35.7562	7.3322
		34.00	-33.46600*	5.50794	.000	-55.1065	-11.8295
		42.00	-32.14000*	7.36632	.008	-60.9606	-3.2994
		46.00	-14.73600	5.43609	.971	-36.1106	6.6386
		49.00	-37.56600*	5.45946	.000	-59.0232	-16.1128
		51.00	-18.40600	7.29255	.997	-46.9515	10.1355
		53.00	-23.22400	7.72958	.751	-53.4830	7.0350
		61.00	-18.79200	5.47091	.282	-40.2905	2.7065
		63.00	-6.33200	7.21725	1.000	-34.5805	21.9165
		66.00	-19.50000	7.39234	.986	-48.4348	9.4348
		68.00	-18.77200	5.39673	.244	-39.9606	2.4166
		76.00	-19.53600	7.17642	.965	-47.6324	8.5604
		78.00	-5.07600	6.87444	1.000	-31.9839	21.8319
		80.00	-6.34000	5.45676	1.000	-27.7926	15.1126
		83.00	-35.83600*	5.53613	.000	-57.5688	-14.0632
		87.00	-11.35200	7.19629	1.000	-39.4792	16.7752
		95.00	-11.95200	5.40742	1.000	-33.2110	9.3070
		98.00	-24.38000	7.21866	.324	-52.6340	3.8740
		100.00	-31.67600*	5.44145	.000	-53.0633	-10.2687
		108.00	-21.97600	7.19748	.694	-50.1471	6.1951
		110.00	-2.15600	6.87159	1.000	-29.0528	24.7408
		112.00	-13.16400	5.39722	1.000	-34.3846	8.0566
		115.00	-31.37200*	5.47215	.000	-52.8752	-9.8688
		119.00	-16.18400	7.33921	1.000	-44.9104	12.5424
		127.00	-10.92600	5.44596	1.000	-32.3323	10.4763

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	34.00	2.00	2.74000	2.88053	1.000	-8.8489	14.3289
		10.00	13.17600	5.46768	1.000	-8.3032	34.6552
		14.00	17.79200*	2.92752	.000	6.3317	29.2523
		17.00	-1.26600	3.20235	1.000	-13.8022	11.2662
		19.00	29.92800*	5.15084	.000	9.7024	50.1536
		21.00	11.04800	5.89464	1.000	-12.1205	34.2165
		29.00	19.25600*	3.08840	.000	7.1679	31.3441
		31.00	33.46800*	5.50794	.000	11.8295	55.1065
		42.00	1.32600	5.81093	1.000	-21.5093	24.1653
		46.00	18.73200*	3.00793	.000	6.9583	30.5057
		49.00	-4.10000	3.04638	1.000	-16.0238	7.8238
		51.00	15.06000	5.71454	.987	-7.3959	37.5159
		53.00	10.24400	6.26265	1.000	-14.3804	34.8684
		61.00	14.67600*	3.05686	.001	2.6721	26.6799
		63.00	27.13600*	5.61613	.001	5.0615	49.2105
		66.00	13.96800	5.84136	1.000	-8.9897	36.9257
		68.00	14.69600*	2.91773	.000	3.2738	26.1182
		76.00	13.93200	5.56617	.998	-7.9448	35.8088
		78.00	28.39200*	5.17037	.000	8.0691	48.6949
		80.00	27.12600*	3.04512	.000	15.2090	39.0470
		83.00	-2.36600	3.18523	1.000	-14.8351	10.0991
		87.00	22.11600*	5.57631	.044	.1991	44.0329
		95.00	21.51600*	2.95211	.000	9.9599	33.0721
		98.00	9.09800	5.61995	1.000	-12.9937	31.1697
		100.00	1.79200	3.01400	1.000	-10.0054	13.5894
		108.00	11.49200	5.59272	1.000	-10.4819	33.4659
		110.00	31.31200*	5.16658	.000	11.0241	51.5999
		112.00	20.30400*	2.93339	.000	8.8208	31.7872
		115.00	2.09800	3.06907	1.000	-9.9165	14.1085
		119.00	17.28400	5.77398	.771	-5.4071	39.9751
		127.00	22.54000*	3.02212	.000	10.7109	34.3691

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	42.00	2.00	1.41200	5.72009	1.000	-21.0831	23.9071
		10.00	11.84800	7.33627	1.000	-16.8752	40.5712
		14.00	16.46400	5.70308	.874	-5.9671	38.8951
		17.00	-2.59600	5.84591	1.000	-25.5768	20.3848
		19.00	28.60000*	7.10534	.032	.7850	56.4150
		21.00	9.72000	7.66169	1.000	-20.2680	39.7080
		29.00	17.93600	5.78730	.651	-4.8202	40.6762
		31.00	32.14000*	7.36832	.008	3.2994	60.9606
		34.00	-1.32600	5.81093	1.000	-24.1653	21.5093
		46.00	17.40400	5.74476	.732	-5.1839	39.9919
		49.00	-5.42600	5.76499	1.000	-28.0920	17.2360
		51.00	13.73200	7.52401	1.000	-15.7171	43.1811
		53.00	8.91600	7.94630	1.000	-22.1956	40.0276
		61.00	13.34600	5.77584	1.000	-9.3569	36.0529
		63.00	25.80600	7.45105	.250	-3.3558	54.9718
		66.00	12.64000	7.62077	1.000	-17.1877	42.4677
		68.00	13.36600	5.69605	1.000	-9.0443	35.7803
		76.00	12.60400	7.41344	1.000	-16.4129	41.6209
		78.00	27.06400	7.11951	.077	-.8062	54.9342
		80.00	25.80000*	5.76433	.005	3.1386	48.4615
		83.00	-3.69600	5.83955	1.000	-26.6414	19.2494
		87.00	20.79600	7.42107	.928	-8.2586	49.8346
		95.00	20.19600	5.71574	.210	-2.2907	42.6667
		98.00	7.76000	7.45242	1.000	-21.4092	36.9292
		100.00	.46400	5.74794	1.000	-22.1359	23.0639
		108.00	10.16400	7.43191	1.000	-18.9250	39.2530
		110.00	29.98400*	7.11676	.015	2.1246	57.8434
		112.00	18.97600	5.70609	.387	-3.4664	41.4184
		115.00	.76600	5.77701	1.000	-21.9413	23.4773
		119.00	15.95600	7.56925	1.000	-13.6701	45.5821
		127.00	21.21200	5.75221	.124	-1.4039	43.8279

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	46.00	2.00	-15.99200*	2.82646	.000	-27.0627	-4.9213
		10.00	-5.55600	5.39731	1.000	-26.7693	15.6573
		14.00	-.94000	2.79389	1.000	-11.8756	9.9956
		17.00	-20.00000*	3.09066	.000	-32.0593	-7.9407
		19.00	11.19600	5.07608	1.000	-8.7463	31.1383
		21.00	-7.68400	5.82943	1.000	-30.6068	15.2388
		29.00	.52400	2.95203	1.000	-11.0697	12.1177
		31.00	14.73600	5.43609	.971	-6.6386	36.1106
		34.00	-18.73200*	3.00793	.000	-30.5057	-6.9583
		42.00	-17.40400	5.74476	.732	-39.9919	5.1839
		49.00	-22.83200*	2.91619	.000	-34.2539	-11.4101
		51.00	-3.67200	5.64725	1.000	-25.8741	18.5301
		53.00	-8.48800	6.20131	1.000	-32.8818	15.9058
		61.00	-4.05600	2.93957	1.000	-15.5617	7.4497
		63.00	8.40400	5.54967	1.000	-13.4121	30.2201
		66.00	-4.76400	5.77564	1.000	-27.4736	17.9456
		68.00	-4.03600	2.79363	1.000	-14.9316	6.8596
		76.00	-4.80000	5.49908	1.000	-26.4159	16.8159
		78.00	9.66000	5.09590	1.000	-10.3607	29.6807
		80.00	8.39600	2.91688	.674	-3.0208	19.8128
		83.00	-21.10000*	3.05286	.000	-33.0894	-9.1106
		87.00	3.38400	5.50936	1.000	-18.2726	25.0406
		95.00	2.78400	2.81965	1.000	-8.2523	13.8203
		96.00	-9.64400	5.55151	1.000	-31.4673	12.1793
		100.00	-16.94000*	2.89438	.000	-28.2295	-5.6505
		108.00	-7.24000	5.52396	1.000	-28.9543	14.4743
		110.00	12.58000	5.09205	.999	-7.4265	32.5865
		112.00	1.57200	2.80004	1.000	-9.3877	12.5317
		115.00	-16.63600*	2.94187	.000	-28.1507	-5.1213
		119.00	-1.44600	5.70739	1.000	-23.8880	20.9920
		127.00	3.80600	2.89286	1.000	-7.5147	15.1307

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	49.00	2.00	6.84000	2.86931	1.000	-4.3909	18.0709
		10.00	17.27600	5.41683	.541	-4.0185	38.5705
		14.00	21.89200*	2.83524	.000	10.7941	32.9899
		17.00	2.83200	3.11621	1.000	-9.3737	15.0377
		19.00	34.02800*	5.09595	.000	13.9991	54.0569
		21.00	15.14800	5.84936	.993	-7.8498	38.1458
		29.00	23.35600*	3.00107	.000	11.6097	35.1023
		31.00	37.56800*	5.45945	.000	16.1128	59.0232
		34.00	4.10000	3.04638	1.000	-7.8238	16.0238
		42.00	5.42800	5.76499	1.000	-17.2360	28.0920
		46.00	22.83200*	2.91619	.000	11.4101	34.2539
		51.00	19.16000	5.66782	.331	-3.1196	41.4396
		53.00	14.34400	6.22005	1.000	-10.1202	38.8082
		61.00	18.77600*	2.97890	.000	7.1165	30.4355
		63.00	31.23600*	5.57060	.000	9.3410	53.1310
		66.00	18.06800	5.79565	.627	-4.7174	40.8534
		68.00	18.79600*	2.82513	.000	7.7376	29.8544
		76.00	18.03200	5.52021	.450	-3.6636	39.7276
		78.00	32.49200*	5.11668	.000	12.3850	52.5990
		80.00	31.22800*	2.95652	.000	19.6562	42.7998
		83.00	1.73200	3.10063	1.000	-10.4047	13.8687
		87.00	26.21600*	5.53044	.002	4.4799	47.9521
		95.00	25.61600*	2.86063	.000	14.4191	36.8129
		96.00	13.18600	5.57244	1.000	-8.7142	35.0902
		100.00	5.89200	2.92445	1.000	-5.5544	17.3384
		108.00	15.59200	5.54497	.925	-6.2016	37.3856
		110.00	35.41200*	5.11486	.000	15.3202	55.5038
		112.00	24.40400*	2.84130	.000	13.2625	35.5265
		115.00	6.19600	2.98117	1.000	-5.4723	17.8643
		119.00	21.39400	5.72774	.106	-1.1327	43.9007
		127.00	26.64000*	2.93282	.000	15.1609	38.1191

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	51.00	2.00	-12.32000	5.62215	1.000	-34.4276	9.7876
		10.00	-1.88400	7.26218	1.000	-30.3089	26.5409
		14.00	2.73200	5.60484	1.000	-19.3105	24.7745
		17.00	-16.32800	5.75316	.908	-38.9299	6.2739
		19.00	14.86800	7.02673	1.000	-12.6381	42.3741
		21.00	-4.01200	7.59885	1.000	-33.7151	25.6911
		29.00	4.19600	5.69062	1.000	-18.1692	26.5612
		31.00	18.40800	7.29255	.997	-10.1355	46.9515
		34.00	-15.06000	5.71464	.987	-37.5159	7.3959
		42.00	-13.73200	7.52401	1.000	-43.1811	15.7171
		46.00	3.67200	5.64725	1.000	-18.5301	25.8741
		49.00	-19.16000	5.66782	.331	-41.4396	3.1196
		53.00	-4.81600	7.87611	1.000	-35.6538	26.0218
		61.00	-.38400	5.67686	1.000	-22.7053	21.9373
		63.00	12.07600	7.37613	1.000	-16.7943	40.9463
		66.00	-1.09200	7.54753	1.000	-30.6332	28.4492
		68.00	-.36400	5.59973	1.000	-22.3873	21.6593
		76.00	-1.12800	7.33814	1.000	-29.8497	27.5937
		78.00	13.33200	7.04106	1.000	-14.2299	40.8939
		80.00	12.06800	5.66715	1.000	-10.2091	34.3451
		83.00	-17.42800	5.74365	.725	-39.9940	5.1380
		87.00	7.05600	7.34584	1.000	-21.6959	35.8079
		95.00	6.45600	5.61772	1.000	-15.6350	28.5470
		98.00	-5.97200	7.37751	1.000	-34.8477	22.9037
		100.00	-13.26800	5.65049	1.000	-35.4623	8.9463
		108.00	-3.56800	7.35679	1.000	-32.3627	25.2267
		110.00	16.25200	7.03628	1.000	-11.2991	43.8031
		112.00	5.24400	5.60791	1.000	-16.8101	27.2981
		116.00	-12.96400	5.68005	1.000	-35.2897	9.3617
		119.00	2.22400	7.49551	1.000	-27.1135	31.5615
		127.00	7.49000	5.65482	1.000	-14.7506	29.7106

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	53.00	2.00	-7.50400	6.17646	1.000	-31.8121	16.8041
		10.00	2.93200	7.70092	1.000	-27.2155	33.0795
		14.00	7.54800	6.16271	1.000	-16.7011	31.7971
		17.00	-11.51200	6.29791	1.000	-36.2692	13.2452
		19.00	19.68400	7.47929	.987	-9.6022	48.9702
		21.00	.80400	8.00971	1.000	-30.5473	32.1553
		29.00	9.01200	6.24074	1.000	-15.5300	33.5540
		31.00	23.22400	7.72956	.751	-7.0350	53.4830
		34.00	-10.24400	6.26265	1.000	-34.8684	14.3804
		42.00	-8.91600	7.94830	1.000	-40.0276	22.1956
		46.00	8.48800	6.20131	1.000	-15.9058	32.8818
		49.00	-14.34400	6.22005	1.000	-38.8082	10.1202
		51.00	4.81600	7.87611	1.000	-26.0218	35.6538
		61.00	4.43200	6.23011	1.000	-20.0700	28.9340
		63.00	16.89200	7.80846	1.000	-13.6743	47.4583
		66.00	3.72400	7.97057	1.000	-27.4745	34.9225
		68.00	4.45200	6.15607	1.000	-19.7796	28.6636
		76.00	3.68800	7.77259	1.000	-26.7385	34.1145
		78.00	18.14800	7.49275	1.000	-11.1905	47.4865
		80.00	16.89400	6.21944	.969	-7.5779	41.3459
		83.00	-12.61200	6.28922	1.000	-37.3365	12.1125
		87.00	11.87200	7.77986	1.000	-18.5628	42.3268
		95.00	11.27200	6.17443	1.000	-13.0210	35.5650
		98.00	-1.15600	7.80977	1.000	-31.7274	29.4154
		100.00	-8.45200	6.20426	1.000	-32.8569	15.9529
		108.00	1.24800	7.79020	1.000	-29.2471	31.7431
		110.00	21.06800	7.49014	.921	-8.2603	50.3963
		112.00	10.06000	6.16560	1.000	-14.1995	34.3195
		116.00	-8.14600	6.23120	1.000	-32.6541	16.3581
		119.00	7.04000	7.82133	1.000	-23.9663	38.0463
		127.00	12.29600	6.20821	1.000	-12.1237	36.7157

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	61.00	2.00	-11.93600*	2.89105	.021	-23.2521	-.6199
		10.00	-1.50000	5.43037	1.000	-22.8381	19.8381
		14.00	3.11600	2.85724	1.000	-8.0682	14.3002
		17.00	-15.94400*	3.13623	.000	-28.2278	-3.6602
		19.00	15.25200	5.11122	.780	-4.8234	35.3274
		21.00	-3.62600	5.86005	1.000	-26.6661	19.4101
		29.00	4.58000	3.02186	1.000	-7.2476	16.4076
		31.00	18.79200	5.47091	.282	-2.7065	40.2905
		34.00	-14.67600*	3.06686	.001	-26.6799	-2.6721
		42.00	-13.34600	5.77584	1.000	-36.0529	9.3589
		46.00	4.05600	2.93957	1.000	-7.4497	15.5617
		49.00	-18.77600*	2.97890	.000	-30.4355	-7.1165
		51.00	.38400	5.67686	1.000	-21.9373	22.7053
		53.00	-4.43200	6.23011	1.000	-28.9340	20.0700
		63.00	12.46000	5.59183	1.000	-9.4774	34.3974
		66.00	-.70600	5.80645	1.000	-23.5340	22.1180
		68.00	.02000	2.84721	1.000	-11.1251	11.1651
		76.00	-.74400	5.53164	1.000	-22.4624	20.9944
		78.00	13.71600	5.13090	.980	-6.4372	33.8692
		80.00	12.45200*	2.97762	.017	.7976	24.1064
		83.00	-17.04400*	3.12076	.000	-29.2593	-4.8287
		87.00	7.44000	5.54175	1.000	-14.3388	29.2188
		95.00	6.84000	2.89244	1.000	-4.4425	18.1225
		98.00	-5.59600	5.59366	1.000	-27.5328	16.3566
		100.00	-12.89400*	2.94578	.007	-24.4139	-1.3541
		108.00	-3.19400	5.55626	1.000	-25.0202	18.6522
		110.00	16.63600	5.12709	.473	-3.5021	36.7741
		112.00	5.62800	2.86326	1.000	-5.5797	16.8357
		115.00	-12.58000*	3.00210	.016	-24.3303	-.8297
		119.00	2.80600	5.73666	1.000	-19.9499	25.1659
		127.00	7.86400	2.95409	.982	-3.6984	19.4264

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	63.00	2.00	-24.39600*	5.52413	.007	-46.1158	-2.6762
		10.00	-13.96000	7.18657	1.000	-42.0885	14.1685
		14.00	-9.34400	5.50651	1.000	-30.9975	12.3095
		17.00	-28.40400*	5.65741	.000	-50.6271	-6.1609
		19.00	2.79200	6.94855	1.000	-24.4071	29.9911
		21.00	-16.08600	7.51652	1.000	-45.5084	13.3324
		29.00	-7.88000	5.59369	1.000	-29.8622	14.1022
		31.00	6.33200	7.21725	1.000	-21.9165	34.5605
		34.00	-27.13600*	5.61613	.001	-49.2105	-5.0615
		42.00	-25.80600	7.45105	.250	-54.9718	3.3558
		46.00	-8.40400	5.54967	1.000	-30.2201	13.4121
		49.00	-31.23600*	5.57060	.000	-53.1310	-9.3410
		51.00	-12.07600	7.37613	1.000	-40.9463	16.7943
		53.00	-16.89200	7.80646	1.000	-47.4583	13.6743
		61.00	-12.46000	5.59183	1.000	-34.3974	9.4774
		66.00	-13.16600	7.47480	1.000	-42.4249	16.0689
		68.00	-12.44000	5.50131	1.000	-34.0740	9.1940
		76.00	-13.20400	7.26331	1.000	-41.6327	15.2247
		78.00	1.25600	6.96304	1.000	-25.9996	28.5116
		80.00	-.00600	5.56992	1.000	-21.9004	21.8844
		83.00	-29.50400*	5.64774	.000	-51.6905	-7.3175
		87.00	-5.02000	7.27109	1.000	-33.4791	23.4391
		95.00	-5.62000	5.51962	1.000	-27.3229	16.0629
		98.00	-18.04600	7.30308	.999	-46.6323	10.5363
		100.00	-25.34400*	5.55296	.004	-47.1725	-3.5155
		108.00	-15.64400	7.28215	1.000	-44.1464	12.8584
		110.00	4.17600	6.96023	1.000	-23.0688	31.4206
		112.00	-6.83200	5.50963	1.000	-28.4973	14.8333
		115.00	-25.04000*	5.59305	.005	-46.9619	-3.0981
		119.00	-9.85200	7.42227	1.000	-38.9030	19.1990
		127.00	-4.59600	5.55738	1.000	-26.4411	17.2491

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	66.00	2.00	-11.22800	5.75099	1.000	-33.8453	11.3893
		10.00	-.79200	7.36238	1.000	-29.6098	28.0258
		14.00	3.82400	5.73407	1.000	-18.7297	26.3777
		17.00	-15.23600	5.87913	.993	-38.3364	7.8644
		19.00	15.96000	7.13024	1.000	-11.9528	43.8728
		21.00	-2.92000	7.69479	1.000	-32.9983	27.1583
		29.00	5.28600	5.81785	1.000	-17.5810	28.1570
		31.00	19.50000	7.39234	.986	-9.4348	48.4348
		34.00	-13.98600	5.84136	1.000	-36.9257	8.9597
		42.00	-12.64000	7.62077	1.000	-42.4677	17.1877
		46.00	4.76400	5.77564	1.000	-17.9456	27.4736
		49.00	-18.06800	5.79565	.627	-40.8534	4.7174
		51.00	1.09200	7.54753	1.000	-28.4492	30.6332
		53.00	-3.72400	7.97067	1.000	-34.9225	27.4745
		61.00	.70800	5.80645	1.000	-22.1180	23.5340
		63.00	13.16800	7.47480	1.000	-16.0889	42.4249
		68.00	.72800	5.72908	1.000	-21.8070	23.2630
		76.00	-.03600	7.43732	1.000	-29.1464	29.0744
		78.00	14.42400	7.14436	1.000	-13.5438	42.3918
		80.00	13.16000	5.79500	1.000	-9.6229	35.9429
		83.00	-16.33600	5.86983	.941	-39.4012	6.7292
		87.00	8.14600	7.44492	1.000	-20.9921	37.2681
		95.00	7.54800	5.74667	1.000	-15.0530	30.1490
		98.00	-4.88000	7.47616	1.000	-34.1422	24.3822
		100.00	-12.17600	5.77670	1.000	-34.8975	10.5455
		108.00	-2.47600	7.45572	1.000	-31.6583	26.7063
		110.00	17.34400	7.14162	1.000	-10.6132	45.3012
		112.00	6.33600	5.73707	1.000	-16.2290	28.9010
		115.00	-11.87200	5.80761	1.000	-34.7024	10.9584
		119.00	3.31600	7.59263	1.000	-26.4016	33.0336
		127.00	8.57200	5.78294	1.000	-14.1655	31.3095

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	68.00	2.00	-11.95600*	2.73234	.007	-22.6505	-1.2615
		10.00	-1.52000	5.34756	1.000	-22.5458	19.5058
		14.00	3.09600	2.69654	1.000	-7.4583	13.6503
		17.00	-15.96400*	2.99265	.000	-27.6809	-4.2471
		19.00	15.23200	5.02315	.728	-4.5104	34.9744
		21.00	-3.64800	5.78340	1.000	-26.3978	19.1018
		29.00	4.56000	2.87039	1.000	-6.6761	15.7961
		31.00	18.77200	5.39673	.244	-2.4166	39.9606
		34.00	-14.69600*	2.91773	.000	-26.1182	-3.2738
		42.00	-13.36800	5.69605	1.000	-35.7803	9.0443
		46.00	4.03600	2.78363	1.000	-6.8596	14.9316
		49.00	-18.79600*	2.82513	.000	-29.8544	-7.7376
		51.00	.36400	5.59973	1.000	-21.6593	22.3873
		53.00	-4.45200	6.15607	1.000	-28.6836	19.7796
		61.00	-.02000	2.84721	1.000	-11.1651	11.1251
		63.00	12.44000	5.50131	1.000	-9.1940	34.0740
		66.00	-.72800	5.72908	1.000	-23.2630	21.8070
		76.00	-.76400	5.45027	1.000	-22.1961	20.6681
		78.00	13.69600	5.04318	.969	-6.1256	33.5176
		80.00	12.43200*	2.82378	.006	1.3789	23.4851
		83.00	-17.06400*	2.97433	.000	-28.7088	-5.4192
		87.00	7.42000	5.46063	1.000	-14.0531	28.8931
		95.00	6.82000	2.72322	.998	-3.8388	17.4788
		98.00	-5.60800	5.50316	1.000	-27.2493	16.0333
		100.00	-12.90400*	2.79019	.002	-23.8253	-1.9627
		108.00	-3.20400	5.47535	1.000	-24.7353	18.3273
		110.00	16.61600	5.03930	.416	-3.1902	36.4222
		112.00	5.60800	2.70291	1.000	-4.9712	16.1872
		115.00	-12.60000*	2.84958	.006	-23.7544	-1.4456
		119.00	2.58800	5.66037	1.000	-19.6752	24.8512
		127.00	7.84400	2.79898	.927	-3.1117	18.7997

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	76.00	2.00	-11.19200	5.47330	1.000	-32.7108	10.3268
		10.00	-.75600	7.14757	1.000	-28.7317	27.2197
		14.00	3.86000	5.45552	1.000	-17.5918	25.3118
		17.00	-15.20000	5.60779	.970	-37.2268	6.8268
		19.00	15.99600	6.90621	1.000	-11.0447	43.0367
		21.00	-2.88400	7.47924	1.000	-32.1589	26.3909
		29.00	5.32400	5.54351	1.000	-16.4596	27.1076
		31.00	19.53600	7.17642	.965	-8.5604	47.6324
		34.00	-13.93200	5.56617	.998	-35.8088	7.9448
		42.00	-12.60400	7.41344	1.000	-41.6209	16.4129
		46.00	4.80000	5.49908	1.000	-16.8159	26.4159
		49.00	-18.03200	5.52021	.450	-39.7276	3.6636
		51.00	1.12600	7.33614	1.000	-27.5937	29.8497
		53.00	-3.69600	7.77259	1.000	-34.1145	26.7385
		61.00	.74400	5.53164	1.000	-20.9944	22.4824
		63.00	13.20400	7.28331	1.000	-15.2247	41.6327
		66.00	.03600	7.43732	1.000	-29.0744	29.1464
		68.00	.76400	5.45027	1.000	-20.6681	22.1961
		78.00	14.46000	6.92279	1.000	-12.6376	41.5576
		80.00	13.19600	5.51952	1.000	-8.4970	34.8890
		83.00	-16.30000	5.59603	.651	-38.2698	5.6698
		87.00	8.18400	7.23256	1.000	-20.1243	36.4923
		95.00	7.58400	5.46675	1.000	-13.9177	29.0857
		98.00	-4.84400	7.26472	1.000	-33.2782	23.5902
		100.00	-12.14000	5.50241	1.000	-33.7685	9.4685
		108.00	-2.44000	7.24367	1.000	-30.7918	25.9118
		110.00	17.38000	6.91996	.998	-9.7065	44.4665
		112.00	6.37200	5.45667	1.000	-15.0917	27.8357
		116.00	-11.83600	5.53276	1.000	-33.5790	9.9070
		119.00	3.35200	7.39452	1.000	-25.5515	32.2555
		127.00	8.60800	5.50686	1.000	-13.0373	30.2533

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	78.00	2.00	-25.65200*	5.06806	.000	-45.5675	-5.7365
		10.00	-15.21600	6.84222	1.000	-41.9975	11.5655
		14.00	-10.60000	5.04685	1.000	-30.4430	9.2430
		17.00	-29.66000*	5.21302	.000	-50.1248	-9.1952
		19.00	1.53600	6.59179	1.000	-24.2643	27.3363
		21.00	-17.34400	7.18600	1.000	-45.4834	10.7954
		29.00	-9.13600	5.14380	1.000	-29.3381	11.0661
		31.00	5.07600	6.87444	1.000	-21.8319	31.9839
		34.00	-28.39200*	5.17037	.000	-48.6949	-8.0891
		42.00	-27.06400	7.11951	.077	-54.9342	.8062
		46.00	-9.66000	5.09590	1.000	-29.6807	10.3607
		49.00	-32.49200*	5.11668	.000	-52.5990	-12.3850
		51.00	-13.33200	7.04106	1.000	-40.8939	14.2299
		53.00	-18.14600	7.49275	1.000	-47.4865	11.1905
		61.00	-13.71600	5.13090	.980	-33.8692	6.4372
		63.00	-1.25600	6.86304	1.000	-28.5116	25.9996
		66.00	-14.42400	7.14436	1.000	-42.3918	13.5438
		68.00	-13.69600	5.04318	.969	-33.5176	6.1256
		76.00	-14.46000	6.92279	1.000	-41.5576	12.6376
		80.00	-1.26400	5.11794	1.000	-21.3681	18.8401
		83.00	-30.76000*	5.20252	.000	-51.1850	-10.3350
		87.00	-6.27600	6.93095	1.000	-33.4056	20.8536
		95.00	-6.87600	5.06315	1.000	-26.7730	13.0210
		98.00	-19.30400	6.96451	.944	-46.5653	7.9573
		100.00	-26.60000*	5.09948	.000	-46.6343	-6.5657
		108.00	-16.90000	6.94255	1.000	-44.0752	10.2752
		110.00	2.92000	6.60410	1.000	-22.9285	28.7685
		112.00	-8.08600	5.05226	1.000	-27.9438	11.7678
		116.00	-26.29600*	5.13222	.000	-46.4542	-6.1378
		119.00	-11.10800	7.09938	1.000	-38.8598	16.6438
		127.00	-5.85200	5.10429	1.000	-25.9045	14.2005

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	80.00	2.00	-24.38800*	2.86798	.000	-35.6136	-13.1624
		10.00	-13.95200	5.41813	.995	-35.2439	7.3399
		14.00	-9.33600	2.83390	.408	-20.4286	1.7566
		17.00	-28.39600*	3.11699	.000	-40.5969	-16.1951
		19.00	2.80000	5.09821	1.000	-17.2261	22.8261
		21.00	-16.08000	5.84871	.957	-39.0754	6.9154
		29.00	-7.87200	2.99980	.988	-19.6133	3.8693
		31.00	6.34000	5.45876	1.000	-15.1126	27.7926
		34.00	-27.12800*	3.04512	.000	-39.0470	-15.2090
		42.00	-25.80000*	5.76433	.005	-48.4615	-3.1385
		46.00	-8.39600	2.91688	.874	-19.8128	3.0208
		49.00	-31.22800*	2.95652	.000	-42.7998	-19.6562
		51.00	-12.06800	5.66715	1.000	-34.3451	10.2091
		53.00	-16.88400	6.21944	.989	-41.3459	7.5779
		61.00	-12.45200*	2.97762	.017	-24.1064	-.7976
		63.00	.00800	5.56992	1.000	-21.8844	21.9004
		66.00	-13.16000	5.79500	1.000	-35.9429	9.6229
		68.00	-12.43200*	2.82378	.008	-23.4851	-1.3789
		76.00	-13.19600	5.51952	1.000	-34.8890	8.4970
		78.00	1.26400	5.11794	1.000	-18.8401	21.3681
		83.00	-29.49600*	3.09940	.000	-41.6279	-17.3641
		87.00	-5.01200	5.52975	1.000	-26.7455	16.7215
		95.00	-5.61200	2.85929	1.000	-16.8037	5.5797
		98.00	-18.04000	5.57175	.483	-39.9397	3.8597
		100.00	-25.33600*	2.82314	.000	-36.7772	-13.8948
		108.00	-15.63600	5.54429	.920	-37.4270	6.1550
		110.00	4.18400	5.11411	1.000	-15.9050	24.2730
		112.00	-6.82400	2.83996	1.000	-17.9402	4.2922
		115.00	-25.03200*	2.97989	.000	-36.6953	-13.3687
		119.00	-9.84400	5.72708	1.000	-32.3582	12.6702
		127.00	-4.59600	2.83152	1.000	-16.0620	6.8660

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	83.00	2.00	5.10800	3.01633	1.000	-6.7001	16.9161
		10.00	15.54400	5.49609	.915	-6.0504	37.1384
		14.00	20.16000*	2.98394	.000	8.4779	31.8421
		17.00	1.10000	3.25400	1.000	-11.6362	13.8362
		19.00	32.29600*	5.18311	.000	11.9478	52.6442
		21.00	13.41600	5.92286	1.000	-9.8590	36.6910
		29.00	21.62400*	3.14193	.000	9.3261	33.9219
		31.00	35.83600*	5.53813	.000	14.0832	57.5888
		34.00	2.36800	3.18523	1.000	-10.0991	14.8351
		42.00	3.69600	5.83965	1.000	-19.2494	26.6414
		46.00	21.10000*	3.06286	.000	9.1106	33.0894
		49.00	-1.73200	3.10063	1.000	-13.8687	10.4047
		51.00	17.42800	5.74365	.725	-5.1380	39.9940
		53.00	12.61200	6.28922	1.000	-12.1125	37.3365
		61.00	17.04400*	3.12076	.000	4.8287	29.2593
		63.00	29.50400*	5.64774	.000	7.3175	51.6905
		66.00	16.33600	5.86983	.941	-6.7292	39.4012
		68.00	17.06400*	2.97433	.000	5.4192	28.7088
		76.00	16.30000	5.59603	.651	-5.6898	38.2898
		78.00	30.76000*	5.20252	.000	10.3350	51.1850
		80.00	29.49600*	3.09940	.000	17.3641	41.6279
		87.00	24.48400*	5.60813	.008	2.4543	46.5137
		95.00	23.89400*	3.00607	.000	12.1080	35.6600
		98.00	11.45600	5.64954	1.000	-10.7376	33.6496
		100.00	4.16000	3.06683	1.000	-7.8526	16.1726
		108.00	13.86000	5.62246	.999	-8.2264	35.9464
		110.00	33.68000*	5.19676	.000	13.2699	54.0901
		112.00	22.67200*	2.98970	.000	10.9675	34.3765
		115.00	4.46400	3.12293	1.000	-7.7597	16.6877
		119.00	19.65200	5.80279	.325	-3.1479	42.4519
		127.00	24.90600*	3.07680	.000	12.8643	36.9517

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	87.00	2.00	-19.37600	5.49362	.208	-40.9356	2.1636
		10.00	-8.94000	7.15548	1.000	-36.9467	19.0667
		14.00	-4.32400	5.46587	1.000	-25.8168	17.1688
		17.00	-23.38400*	5.61787	.020	-45.4506	-1.3174
		19.00	7.81200	6.91639	1.000	-19.2608	34.8848
		21.00	-11.06600	7.49680	1.000	-40.3724	18.2364
		29.00	-2.86000	5.55370	1.000	-24.6639	18.9639
		31.00	11.35200	7.18629	1.000	-16.7752	39.4792
		34.00	-22.11600*	5.57631	.044	-44.0329	-.1991
		42.00	-20.78600	7.42107	.928	-49.8346	8.2586
		46.00	-3.38400	5.50936	1.000	-25.0406	18.2726
		49.00	-26.21600*	5.53044	.002	-47.9521	-4.4799
		51.00	-7.05600	7.34584	1.000	-35.8079	21.6959
		53.00	-11.87200	7.77986	1.000	-42.3268	18.5828
		61.00	-7.44000	5.54175	1.000	-29.2188	14.3388
		63.00	5.02000	7.27109	1.000	-23.4391	33.4791
		66.00	-8.14600	7.44492	1.000	-37.2681	20.9921
		68.00	-7.42000	5.46083	1.000	-28.8931	14.0531
		76.00	-8.18400	7.23256	1.000	-36.4923	20.1243
		78.00	6.27600	6.93095	1.000	-20.8536	33.4056
		80.00	5.01200	5.52975	1.000	-16.7215	26.7455
		83.00	-24.48400*	5.60813	.008	-46.5137	-2.4543
		95.00	-.60000	5.47908	1.000	-22.1425	20.9425
		98.00	-13.02800	7.27250	1.000	-41.4926	15.4366
		100.00	-20.32400	5.51267	.124	-41.9931	1.3451
		108.00	-10.62400	7.25148	1.000	-39.0063	17.7583
		110.00	9.19600	6.92813	1.000	-17.9226	36.3146
		112.00	-1.81200	5.46902	1.000	-23.3166	19.6926
		115.00	-20.02000	5.54297	.160	-41.8034	1.7634
		119.00	-4.83200	7.39217	1.000	-33.7654	24.1014
		127.00	.42400	5.51712	1.000	-21.2618	22.1098

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	95.00	2.00	-18.77600*	2.76903	.000	-29.6140	-7.9380
		10.00	-8.34000	5.36640	1.000	-29.4367	12.7567
		14.00	-3.72400	2.73371	1.000	-14.4238	6.9758
		17.00	-22.78400*	3.02619	.000	-34.6312	-10.9368
		19.00	8.41200	5.04320	1.000	-11.4061	28.2301
		21.00	-10.46600	5.80082	1.000	-33.2633	12.3473
		29.00	-2.26000	2.80534	1.000	-13.6324	9.1124
		31.00	11.95200	5.40742	1.000	-9.3070	33.2110
		34.00	-21.51600*	2.95211	.000	-33.0721	-9.9599
		42.00	-20.18600	5.71574	.210	-42.6667	2.2907
		46.00	-2.78400	2.81965	1.000	-13.8203	8.2523
		49.00	-25.61600*	2.86063	.000	-36.8129	-14.4191
		51.00	-6.45600	5.61772	1.000	-28.5470	15.6350
		53.00	-11.27200	6.17443	1.000	-35.5650	13.0210
		61.00	-6.84000	2.89244	1.000	-18.1225	4.4426
		63.00	5.62000	5.51962	1.000	-16.0829	27.3229
		66.00	-7.54600	5.74667	1.000	-30.1490	15.0530
		68.00	-6.82000	2.72322	.998	-17.4788	3.8388
		76.00	-7.58400	5.46875	1.000	-29.0857	13.9177
		78.00	6.87600	5.06315	1.000	-13.0210	26.7730
		80.00	5.61200	2.85929	1.000	-5.5797	16.8037
		83.00	-23.88400*	3.00607	.000	-35.6600	-12.1080
		87.00	.60000	5.47908	1.000	-20.9425	22.1425
		98.00	-12.42800	5.52147	1.000	-34.1382	9.2622
		100.00	-19.72400*	2.82612	.000	-30.7857	-8.6623
		108.00	-10.02400	5.49375	1.000	-31.6246	11.5766
		110.00	9.79600	5.05928	1.000	-10.0857	29.6777
		112.00	-1.21200	2.74000	1.000	-11.9364	9.5124
		115.00	-19.42000*	2.88478	.000	-30.7117	-8.1283
		119.00	-4.23200	5.67617	1.000	-26.5621	18.0981
		127.00	1.02400	2.83478	1.000	-10.0716	12.1196

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Tamhane	98.00	2.00	-6.34600	5.52597	1.000	-28.0752	15.3792
		10.00	4.09600	7.19799	1.000	-24.0461	32.2221
		14.00	8.70400	5.50636	1.000	-12.9569	30.3649
		17.00	-10.35600	5.65921	1.000	-32.5662	11.8742
		19.00	20.84000	6.95002	.757	-6.3648	48.0448
		21.00	1.96000	7.51787	1.000	-27.4657	31.3857
		29.00	10.16600	5.59552	1.000	-11.8214	32.1574
		31.00	24.38000	7.21666	.324	-3.8740	52.6340
		34.00	-9.08600	5.61995	1.000	-31.1697	12.9937
		42.00	-7.76000	7.45242	1.000	-36.9292	21.4092
		46.00	9.64400	5.55151	1.000	-12.1793	31.4673
		49.00	-13.18600	5.57244	1.000	-35.0902	8.7142
		51.00	5.97200	7.37751	1.000	-22.9037	34.8477
		53.00	1.15600	7.80977	1.000	-29.4154	31.7274
		61.00	5.58600	5.58366	1.000	-16.3566	27.5326
		63.00	18.04600	7.30308	.999	-10.5363	46.6323
		66.00	4.88000	7.47616	1.000	-24.3622	34.1422
		68.00	5.60600	5.50316	1.000	-16.0333	27.2493
		76.00	4.84400	7.26472	1.000	-23.5902	33.2782
		78.00	19.30400	6.96451	.944	-7.9573	46.5653
		80.00	18.04000	5.57175	.483	-3.8597	39.9397
		83.00	-11.45600	5.64954	1.000	-33.6496	10.7376
		87.00	13.02600	7.27260	1.000	-15.4366	41.4926
		95.00	12.42600	5.52147	1.000	-9.2622	34.1382
		100.00	-7.29600	5.55480	1.000	-29.1317	14.5397
		108.00	2.40400	7.29366	1.000	-26.1039	30.9119
		110.00	22.22400	6.98169	.525	-5.0264	49.4744
		112.00	11.21600	5.51148	1.000	-10.4566	32.8886
		115.00	-6.99200	5.59487	1.000	-28.9412	14.9572
		119.00	8.19600	7.42364	1.000	-20.8604	37.2524
		127.00	13.45200	5.55921	1.000	-8.4004	35.3044

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Tamhane	100.00	2.00	.94600	2.83491	1.000	-10.1480	12.0440
		10.00	11.38400	5.40069	1.000	-9.8420	32.6100
		14.00	16.00000*	2.80042	.000	5.0387	26.9613
		17.00	-3.06000	3.09659	1.000	-15.1424	9.0224
		19.00	28.13600*	5.07968	.000	8.1801	48.0919
		21.00	9.25600	5.83256	1.000	-13.6786	32.1906
		29.00	17.46400*	2.96620	.000	5.8462	29.0818
		31.00	31.67600*	5.44145	.000	10.2887	53.0633
		34.00	-1.79200	3.01400	1.000	-13.5894	10.0054
		42.00	-.46400	5.74794	1.000	-23.0639	22.1359
		46.00	16.94000*	2.89438	.000	5.6505	28.2295
		49.00	-5.89200	2.92445	1.000	-17.3384	5.5544
		51.00	13.26600	5.65049	1.000	-8.9463	35.4823
		53.00	8.45200	6.20426	1.000	-15.9529	32.8569
		61.00	12.88400*	2.94578	.007	1.3541	24.4139
		63.00	25.34400*	5.55296	.004	3.5155	47.1725
		66.00	12.17600	5.77670	1.000	-10.5455	34.8975
		68.00	12.90400*	2.79019	.002	1.9827	23.8253
		76.00	12.14000	5.50241	1.000	-9.4885	33.7685
		78.00	26.60000*	5.09948	.000	6.5657	46.6343
		80.00	25.33600*	2.92314	.000	13.8948	36.7772
		83.00	-4.16000	3.06683	1.000	-16.1726	7.8526
		87.00	20.32400	5.51267	.124	-1.3451	41.9931
		95.00	19.72400*	2.82612	.000	8.6623	30.7857
		98.00	7.29600	5.55480	1.000	-14.5397	29.1317
		108.00	9.70000	5.52725	1.000	-12.0268	31.4268
		110.00	29.52000*	5.09564	.000	9.5009	49.5391
		112.00	18.51200*	2.80656	.000	7.5268	29.4972
		115.00	.30400	2.94608	1.000	-11.2349	11.8429
		119.00	15.49200	5.71059	.970	-6.9601	37.9441
		127.00	20.74600*	2.89917	.000	9.4006	32.0954

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	108.00	2.00	-8.75200	5.49828	1.000	-30.3696	12.8656
		10.00	1.68400	7.16672	1.000	-26.3667	29.7347
		14.00	6.30000	5.48058	1.000	-15.2510	27.8510
		17.00	-12.76000	5.63217	1.000	-34.8832	9.3632
		19.00	18.43600	6.92602	.982	-8.6825	45.5545
		21.00	-.44400	7.49754	1.000	-29.7903	28.9023
		29.00	7.76400	5.58617	1.000	-14.1172	29.6452
		31.00	21.97600	7.19748	.694	-6.1951	50.1471
		34.00	-11.49200	5.59272	1.000	-33.4659	10.4619
		42.00	-10.16400	7.43191	1.000	-39.2530	18.9250
		46.00	7.24000	5.52395	1.000	-14.4743	28.9543
		49.00	-15.59200	5.54497	.926	-37.3856	6.2016
		51.00	3.56600	7.35679	1.000	-25.2267	32.3627
		53.00	-1.24600	7.79020	1.000	-31.7431	29.2471
		61.00	3.18400	5.55626	1.000	-18.6522	25.0202
		63.00	15.64400	7.28215	1.000	-12.8584	44.1464
		66.00	2.47600	7.45572	1.000	-26.7063	31.6583
		68.00	3.20400	5.47535	1.000	-18.3273	24.7353
		76.00	2.44000	7.24367	1.000	-25.9118	30.7918
		78.00	16.90000	6.94255	1.000	-10.2752	44.0752
		80.00	15.63600	5.54429	.920	-6.1550	37.4270
		83.00	-13.86000	5.62246	.999	-35.9464	8.2264
		87.00	10.62400	7.25148	1.000	-17.7583	39.0063
		95.00	10.02400	5.49375	1.000	-11.5766	31.6246
		98.00	-2.40400	7.28366	1.000	-30.9119	26.1039
		100.00	-9.70000	5.52725	1.000	-31.4268	12.0268
		110.00	19.82000	6.93973	.692	-7.3442	46.9842
		112.00	8.81200	5.48372	1.000	-12.7508	30.3748
		115.00	-9.39600	5.55747	1.000	-31.2368	12.4448
		119.00	5.79200	7.40305	1.000	-23.1839	34.7679
		127.00	11.04800	5.53169	1.000	-10.6955	32.7915

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	110.00	2.00	-28.57200*	5.08420	.000	-48.4722	-8.6718
		10.00	-18.13600	6.83936	.984	-44.9063	8.6343
		14.00	-13.52000	5.04497	.979	-33.3476	6.3076
		17.00	-32.58000*	5.20928	.000	-53.0300	-12.1300
		19.00	-1.38400	6.59582	1.000	-27.1727	24.4047
		21.00	-20.26400	7.18527	.917	-48.3928	7.8648
		29.00	-12.05600	5.14000	1.000	-32.2431	8.1311
		31.00	2.15600	6.87159	1.000	-24.7408	29.0528
		34.00	-31.31200*	5.16658	.000	-51.5999	-11.0241
		42.00	-29.98400*	7.11676	.015	-57.8434	-2.1246
		46.00	-12.58000	5.09205	.999	-32.5655	7.4255
		49.00	-35.41200*	5.11486	.000	-55.5038	-15.3202
		51.00	-16.25200	7.03628	1.000	-43.8031	11.2991
		53.00	-21.06600	7.49014	.921	-50.3963	8.2603
		61.00	-16.63600	5.12709	.473	-36.7741	3.5021
		63.00	-4.17600	6.96023	1.000	-31.4206	23.0686
		66.00	-17.34400	7.14162	1.000	-45.3012	10.6132
		68.00	-16.61600	5.03930	.416	-36.4222	3.1902
		76.00	-17.38000	6.91996	.998	-44.4665	9.7065
		78.00	-2.92000	6.60410	1.000	-28.7685	22.9285
		80.00	-4.18400	5.11411	1.000	-24.2730	15.9050
		83.00	-33.68000*	5.19576	.000	-54.0901	-13.2699
		87.00	-9.19600	6.92513	1.000	-36.3146	17.9226
		95.00	-9.79600	5.05928	1.000	-29.6777	10.0857
		98.00	-22.22400	6.96169	.525	-49.4744	5.0264
		100.00	-29.52000*	5.09564	.000	-49.5391	-9.5009
		108.00	-19.82000	6.93973	.692	-46.9842	7.3442
		112.00	-11.00800	5.04638	1.000	-30.8485	8.8325
		115.00	-29.21600*	5.12841	.000	-49.3591	-9.0729
		119.00	-14.02800	7.08662	1.000	-41.7690	13.7130
		127.00	-8.77200	5.10045	1.000	-28.8093	11.2653

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	112.00	2.00	-17.56400*	2.74906	.000	-28.3239	-6.8041
		10.00	-7.12600	5.35613	1.000	-28.1820	13.9300
		14.00	-2.51200	2.71348	1.000	-13.1326	8.1086
		17.00	-21.57200*	3.00793	.000	-33.3482	-9.7958
		19.00	9.62400	5.03227	1.000	-10.1528	29.4008
		21.00	-9.25600	5.79132	1.000	-32.0356	13.5236
		29.00	-1.04800	2.85631	1.000	-12.3462	10.2502
		31.00	13.16400	5.39722	1.000	-8.0566	34.3846
		34.00	-20.30400*	2.93339	.000	-31.7872	-8.8208
		42.00	-18.97600	5.70609	.387	-41.4184	3.4664
		46.00	-1.57200	2.80004	1.000	-12.5317	9.3877
		49.00	-24.40400*	2.84130	.000	-35.5255	-13.2825
		51.00	-5.24400	5.60791	1.000	-27.2981	16.8101
		53.00	-10.06000	6.16550	1.000	-34.3195	14.1995
		61.00	-5.62800	2.86326	1.000	-16.8357	5.5797
		63.00	6.83200	5.50963	1.000	-14.8333	28.4973
		66.00	-6.33600	5.73707	1.000	-28.9010	16.2290
		68.00	-5.60800	2.70291	1.000	-16.1872	4.9712
		76.00	-6.37200	5.45667	1.000	-27.8357	15.0917
		78.00	8.08800	5.05226	1.000	-11.7678	27.9438
		80.00	6.82400	2.83996	1.000	-4.2922	17.9402
		83.00	-22.67200*	2.99970	.000	-34.3765	-10.9675
		87.00	1.81200	5.46902	1.000	-19.6926	23.3166
		95.00	1.21200	2.74000	1.000	-9.5124	11.9364
		98.00	-11.21600	5.51148	1.000	-32.8886	10.4566
		100.00	-18.51200*	2.80656	.000	-29.4972	-7.5268
		108.00	-8.81200	5.49372	1.000	-30.3748	12.7508
		110.00	11.00800	5.04638	1.000	-8.8325	30.8485
		115.00	-18.20800*	2.86562	.000	-29.4249	-6.9911
		119.00	-3.02000	5.66646	1.000	-25.3136	19.2736
		127.00	2.23600	2.81528	1.000	-8.7834	13.2554

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tamhane	115.00	2.00	.64400	2.89339	1.000	-10.6813	11.9693
		10.00	11.08000	5.43162	1.000	-10.2628	32.4228
		14.00	15.69600*	2.85961	.000	4.5025	26.8895
		17.00	-3.36400	3.14038	1.000	-15.6562	8.9282
		19.00	27.83200*	5.11254	.000	7.7516	47.9124
		21.00	8.95200	5.86121	1.000	-14.0904	31.9944
		29.00	17.16000*	3.02410	.000	5.3236	28.9964
		31.00	31.37200*	5.47215	.000	9.8688	52.8752
		34.00	-2.09600	3.05907	1.000	-14.1085	9.9165
		42.00	-.76800	5.77701	1.000	-23.4773	21.9413
		46.00	16.63600*	2.94187	.000	5.1213	28.1507
		49.00	-6.19600	2.99117	1.000	-17.8643	5.4723
		51.00	12.96400	5.69005	1.000	-9.3617	35.2897
		53.00	8.14800	6.23120	1.000	-16.3581	32.6541
		61.00	12.58000*	3.00210	.016	.8297	24.3303
		63.00	25.04000*	5.59305	.005	3.0981	46.9819
		66.00	11.87200	5.80761	1.000	-10.9584	34.7024
		68.00	12.60000*	2.84958	.008	1.4456	23.7544
		76.00	11.83600	5.53276	1.000	-9.9070	33.5790
		78.00	26.29600*	5.13222	.000	6.1378	46.4542
		80.00	25.03200*	2.97989	.000	13.3687	36.6953
		83.00	-4.46400	3.12293	1.000	-16.6877	7.7597
		87.00	20.02000	5.64297	.160	-1.7634	41.8034
		95.00	19.42000*	2.88478	.000	8.1283	30.7117
		98.00	6.99200	5.59487	1.000	-14.9572	28.9412
		100.00	-.30400	2.94608	1.000	-11.8429	11.2349
		108.00	9.39600	5.55747	1.000	-12.4448	31.2368
		110.00	29.21600*	5.12641	.000	9.0729	49.3591
		112.00	18.20800*	2.86562	.000	6.9911	29.4249
		119.00	15.18800	5.73984	.986	-7.3743	37.7503
		127.00	20.44400*	2.95638	.000	8.8726	32.0164

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	119.00	2.00	-14.54400	5.68255	.998	-36.8906	7.8026
		10.00	-4.10600	7.30904	1.000	-32.7166	24.5006
		14.00	.50600	5.66542	1.000	-21.7742	22.7902
		17.00	-18.55200	5.81220	.538	-41.3675	4.2635
		19.00	12.64400	7.07515	1.000	-15.0523	40.3403
		21.00	-6.23600	7.63370	1.000	-36.1146	23.6425
		29.00	1.97200	5.75020	1.000	-20.6294	24.5734
		31.00	16.18400	7.33921	1.000	-12.5424	44.9104
		34.00	-17.28400	5.77398	.771	-39.9751	5.4071
		42.00	-15.95600	7.59925	1.000	-45.5821	13.6701
		46.00	1.44600	5.70739	1.000	-20.9920	23.8880
		49.00	-21.39400	5.72774	.105	-43.9007	1.1327
		51.00	-2.22400	7.49551	1.000	-31.5615	27.1135
		53.00	-7.04000	7.92133	1.000	-38.0463	23.9663
		61.00	-2.60600	5.73668	1.000	-25.1659	19.9499
		63.00	9.85200	7.42227	1.000	-19.1990	38.9030
		66.00	-3.31600	7.59263	1.000	-33.0336	26.4016
		68.00	-2.59600	5.66037	1.000	-24.8512	19.6752
		76.00	-3.35200	7.39452	1.000	-32.2555	25.5515
		78.00	11.10600	7.09938	1.000	-16.6438	38.8598
		80.00	9.84400	5.72708	1.000	-12.6702	32.3582
		83.00	-19.65200	5.80279	.325	-42.4519	3.1479
		87.00	4.83200	7.39217	1.000	-24.1014	33.7654
		95.00	4.23200	5.67617	1.000	-18.0981	26.5621
		98.00	-8.19600	7.42364	1.000	-37.2524	20.8604
		100.00	-15.49200	5.71059	.970	-37.9441	6.9601
		108.00	-5.79200	7.40306	1.000	-34.7679	23.1839
		110.00	14.02600	7.09662	1.000	-13.7130	41.7690
		112.00	3.02000	5.66846	1.000	-19.2736	25.3136
		115.00	-15.18600	5.73984	.986	-37.7503	7.3743
		127.00	5.25600	5.71488	1.000	-17.2122	27.7242

	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tamhane	127.00	2.00	-19.80000*	2.84355	.000	-30.9298	-8.6702
		10.00	-9.36400	5.40523	1.000	-30.6072	11.8792
		14.00	-4.74600	2.80916	1.000	-15.7435	6.2475
		17.00	-23.80600*	3.09452	.000	-35.9213	-11.6947
		19.00	7.39600	5.08450	1.000	-12.5662	27.3622
		21.00	-11.49200	5.83676	1.000	-34.4424	11.4584
		29.00	-3.28400	2.97644	1.000	-14.9340	8.3660
		31.00	10.92600	5.44596	1.000	-10.4763	32.3323
		34.00	-22.54000*	3.02212	.000	-34.3691	-10.7109
		42.00	-21.21200	5.75221	.124	-43.8279	1.4039
		46.00	-3.80800	2.89286	1.000	-15.1307	7.5147
		49.00	-26.64000*	2.93282	.000	-38.1191	-15.1609
		51.00	-7.48000	5.85482	1.000	-29.7108	14.7508
		53.00	-12.29600	6.20621	1.000	-36.7157	12.1237
		61.00	-7.86400	2.85409	.982	-19.4264	3.6984
		63.00	4.59600	5.55738	1.000	-17.2491	26.4411
		66.00	-8.57200	5.78294	1.000	-31.3095	14.1655
		68.00	-7.84400	2.79596	.927	-18.7997	3.1117
		76.00	-8.60800	5.50686	1.000	-30.2533	13.0373
		78.00	5.85200	5.10429	1.000	-14.2005	25.9045
		80.00	4.59600	2.93152	1.000	-6.8660	16.0620
		83.00	-24.90600*	3.07680	.000	-36.9517	-12.8643
		87.00	-.42400	5.51712	1.000	-22.1098	21.2618
		95.00	-1.02400	2.83478	1.000	-12.1196	10.0716
		98.00	-13.45200	5.55921	1.000	-35.3044	8.4004
		100.00	-20.74600*	2.89917	.000	-32.0954	-9.4006
		108.00	-11.04600	5.53169	1.000	-32.7915	10.6955
		110.00	8.77200	5.10045	1.000	-11.2653	28.8093
		112.00	-2.23600	2.81528	1.000	-13.2554	8.7634
		115.00	-20.44400*	2.85638	.000	-32.0154	-8.8726
		119.00	-5.25600	5.71488	1.000	-27.7242	17.2122

J. TAMHANE'S T2 TEST FOR LEVEL 3 WITHOUT UPPER VALUES (EFFORT)

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
10.00	14.00	4.61600	5.35291	1.000	-15.6269	24.8589
	19.00	16.75200	6.62749	.982	-9.9600	42.4640
	21.00	-2.12800	7.40473	1.000	-30.0145	25.7585
	29.00	6.08000	5.44256	1.000	-14.4891	26.6491
	31.00	20.29200	7.10076	.709	-6.4482	47.0322
	46.00	5.55600	5.39731	1.000	-14.8482	25.9602
	51.00	1.88400	7.26219	1.000	-25.4648	29.2328
	53.00	-2.93200	7.70092	1.000	-31.9377	26.0737
	61.00	1.50000	5.43037	1.000	-19.0247	22.0247
	63.00	13.96000	7.18657	1.000	-13.1035	41.0235
	66.00	.79200	7.36239	1.000	-26.9347	29.5187
	68.00	1.52000	5.34758	1.000	-19.7034	21.7434
	76.00	.76800	7.14757	1.000	-26.1606	27.6729
	78.00	15.21600	6.64222	.699	-10.5515	40.9835
	80.00	13.95200	5.41813	.945	-6.5280	34.4320
	87.00	8.94000	7.16549	1.000	-18.0064	35.8864
	95.00	8.34000	5.38640	1.000	-11.9519	28.6318
	98.00	-4.08800	7.18799	1.000	-31.1569	22.9809
	108.00	-1.68400	7.16672	1.000	-28.6727	25.3047
	110.00	18.13600	6.63936	.899	-7.6207	43.8927
	112.00	7.12800	5.35613	1.000	-13.1265	27.3825
	119.00	4.10800	7.30904	1.000	-23.4174	31.6334
	127.00	9.36400	5.40523	1.000	-11.0691	29.7971
14.00	10.00	-4.61600	5.35291	1.000	-24.8589	15.6269
	19.00	12.13600	5.02885	.699	-6.8742	31.1462
	21.00	-6.74400	5.78835	1.000	-28.6429	15.1549
	29.00	1.46400	2.68035	1.000	-9.3840	12.3120
	31.00	15.67600	5.39404	.661	-4.7232	36.0752
	46.00	.94000	2.79389	1.000	-9.5816	11.4616
	51.00	-2.73200	5.60484	1.000	-23.9330	18.4690
	53.00	-7.54800	6.16271	1.000	-30.8704	15.7744
	61.00	-3.11600	2.86724	1.000	-13.8767	7.6447
	63.00	9.34400	5.50651	1.000	-11.4830	30.1710
	66.00	-3.82400	5.73407	1.000	-25.5164	17.8684
	68.00	-3.09600	2.69654	1.000	-13.2607	7.0687
	76.00	-3.86000	6.45552	1.000	-24.4931	16.7731
	78.00	10.60000	5.04885	1.000	-8.4863	29.6863
	80.00	9.33600	2.63390	.253	-1.3366	20.0086
	87.00	4.32400	5.46587	1.000	-16.2484	24.8964
	95.00	3.72400	2.73371	1.000	-6.5707	14.0187
	98.00	-8.70400	5.50836	1.000	-29.5380	12.1300
	108.00	-6.30000	5.48059	1.000	-27.0284	14.4284
	110.00	13.52000	5.04497	.883	-5.5515	32.5915
	112.00	2.51200	2.71348	1.000	-7.7065	12.7305
	119.00	-.50800	5.66642	1.000	-21.6384	20.6234
	127.00	4.74800	2.60918	1.000	-5.8312	15.3272

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
19.00	10.00	-16.75200	6.62749	.982	-42.4640	8.9600
	14.00	-12.13600	5.02885	.699	-31.1462	6.8742
	21.00	-18.68000	7.17396	.912	-45.9010	8.1410
	29.00	-10.67200	5.12417	1.000	-30.0300	8.6860
	31.00	3.54000	6.65976	1.000	-22.2939	29.3739
	46.00	-11.19600	5.07609	1.000	-30.3783	7.9863
	51.00	-14.86800	7.02673	1.000	-41.3325	11.5965
	53.00	-19.68400	7.47929	.912	-47.8606	8.4926
	61.00	-15.25200	5.11122	.689	-34.5629	4.0588
	63.00	-2.79200	6.94855	1.000	-29.9611	23.3771
	66.00	-15.96000	7.13024	.999	-42.8157	10.8957
	68.00	-15.23200	5.02315	.515	-34.2214	3.7574
	76.00	-15.99600	6.90821	.997	-42.0129	10.0209
	78.00	-1.53600	6.59179	1.000	-26.3595	23.2875
	80.00	-2.80000	5.09821	1.000	-22.0631	16.4631
	87.00	-7.81200	6.91639	1.000	-33.8597	18.2357
	95.00	-8.41200	5.04320	1.000	-27.4745	10.6505
	98.00	-20.84000	6.95002	.545	-47.0147	5.3347
	108.00	-18.43600	6.92802	.882	-44.6276	7.6556
	110.00	1.38400	6.58882	1.000	-23.4283	26.1963
	112.00	-9.62400	5.03227	1.000	-28.6466	9.3986
	119.00	-12.64400	7.07515	1.000	-39.2915	14.0035
	127.00	-7.38800	5.08450	1.000	-26.6011	11.8251
21.00	10.00	2.12800	7.40473	1.000	-25.7585	30.0145
	14.00	6.74400	5.78835	1.000	-15.1549	28.6429
	19.00	18.68000	7.17396	.912	-8.1410	45.9010
	29.00	8.20800	5.67135	1.000	-13.9921	30.4081
	31.00	22.42000	7.42452	.625	-5.5784	50.4184
	46.00	7.68400	5.62643	1.000	-14.3638	29.7319
	51.00	4.01200	7.58885	1.000	-24.5685	32.5905
	53.00	-.80400	8.00971	1.000	-30.9682	29.3602
	61.00	3.62800	5.66005	1.000	-18.5311	25.7871
	63.00	16.08800	7.51652	1.000	-12.2185	44.3945
	66.00	2.92000	7.68479	1.000	-26.0195	31.8595
	68.00	3.64800	5.78340	1.000	-18.2329	25.5289
	76.00	2.88400	7.47624	1.000	-25.2824	31.0604
	78.00	17.34400	7.18800	.989	-9.7288	44.4176
	80.00	16.08000	5.64871	.826	-6.0379	38.1979
	87.00	11.06800	7.48680	1.000	-17.1269	39.2628
	95.00	10.46800	5.60082	1.000	-11.4761	32.4121
	98.00	-1.96000	7.51787	1.000	-30.2719	26.3518
	108.00	.44400	7.46754	1.000	-27.7912	28.6792
	110.00	20.28400	7.16527	.749	-6.7594	47.3274
	112.00	9.25600	5.79132	1.000	-12.6536	31.1656
	119.00	6.23600	7.62370	1.000	-22.5113	34.9833
	127.00	11.49200	5.62676	1.000	-10.5825	33.5665

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
29.00	10.00	-6.08000	5.44256	1.000	-26.6491	14.4891
	14.00	-1.46400	2.62035	1.000	-12.3120	9.3840
	19.00	10.67200	5.12417	1.000	-9.6860	30.0300
	21.00	-8.20800	5.67135	1.000	-30.4081	13.9921
	31.00	14.21200	5.48301	.937	-6.5110	34.9350
	46.00	-.52400	2.96203	1.000	-11.6787	10.6307
	51.00	-4.19600	5.69052	1.000	-25.7083	17.3163
	53.00	-9.01200	6.24074	1.000	-32.6171	14.5931
	61.00	-4.58000	3.02186	1.000	-15.9599	6.7999
	63.00	7.88000	5.59369	1.000	-13.2640	29.0240
	66.00	-5.28800	5.61785	1.000	-27.2846	16.7086
	68.00	-4.56000	2.67039	1.000	-15.3706	6.2506
	76.00	-5.32400	5.54351	1.000	-26.2771	15.6291
	78.00	9.13600	5.14380	1.000	-10.2966	29.5686
	80.00	7.67200	2.99680	.916	-3.4249	19.1688
	87.00	2.86000	5.55370	1.000	-18.1319	23.8519
	95.00	2.26000	2.90534	1.000	-8.6819	13.2018
	98.00	-10.16800	5.59552	1.000	-31.3189	10.9829
	108.00	-7.76400	5.58817	1.000	-28.8109	13.2829
	110.00	12.05600	5.14000	.996	-7.3622	31.4742
	112.00	1.04800	2.68631	1.000	-9.8224	11.9184
	119.00	-1.97200	5.75020	1.000	-23.7113	19.7673
	127.00	3.28400	2.97644	1.000	-7.9249	14.4929
31.00	10.00	-20.29200	7.10076	.709	-47.0322	6.4482
	14.00	-15.67600	5.39404	.661	-36.0752	4.7232
	19.00	-3.54000	6.85976	1.000	-29.3739	22.2939
	21.00	-22.42000	7.43452	.525	-50.4184	5.5784
	29.00	-14.21200	5.48301	.937	-34.9350	6.5110
	46.00	-14.72800	5.43809	.880	-35.2954	5.8234
	51.00	-18.40800	7.29255	.983	-45.8709	9.0549
	53.00	-23.22400	7.72656	.639	-52.3370	5.8860
	61.00	-18.79200	5.47091	.189	-39.4709	1.8869
	63.00	-6.33200	7.21725	1.000	-33.5110	20.8470
	66.00	-19.50000	7.39234	.909	-47.3392	8.3392
	68.00	-18.77200	5.38873	.144	-39.1519	1.6079
	76.00	-19.53600	7.17842	.845	-46.5687	7.4967
	78.00	-5.07600	6.87444	1.000	-30.9650	20.8130
	80.00	-6.34000	5.45876	1.000	-26.9746	14.2946
	87.00	-11.35200	7.18629	1.000	-38.4143	15.7103
	95.00	-11.95200	5.40742	1.000	-32.3699	9.4659
	98.00	-24.38000	7.21866	.196	-51.5643	2.8043
	108.00	-21.97600	7.19748	.483	-49.0805	5.1285
	110.00	-2.15600	6.57159	1.000	-28.0343	23.7223
	112.00	-13.16400	5.39722	.689	-33.5749	7.2469
	119.00	-16.18400	7.33921	1.000	-43.8229	11.4549
	127.00	-10.92800	5.44598	1.000	-31.5160	9.6600

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
46.00	10.00	-5.55600	5.39731	1.000	-25.9602	14.8482
	14.00	-.94000	2.79389	1.000	-11.4619	9.5819
	19.00	11.19600	5.07608	1.000	-7.9863	30.3783
	21.00	-7.68400	5.62943	1.000	-29.7319	14.3639
	29.00	.52400	2.96203	1.000	-10.6307	11.6787
	31.00	14.72800	5.43809	.880	-5.8234	35.2954
	51.00	-3.67200	5.64725	1.000	-25.0269	17.6829
	53.00	-8.48800	6.20131	1.000	-31.9501	14.9741
	61.00	-4.05600	2.93957	1.000	-15.1260	7.0140
	63.00	8.40400	5.54967	1.000	-12.5799	29.3879
	66.00	-4.76400	5.77554	1.000	-26.6069	17.0789
	68.00	-4.03600	2.78363	1.000	-14.5190	6.4470
	76.00	-4.80000	5.49909	1.000	-25.5914	15.9914
	78.00	9.66000	5.09590	1.000	-9.5977	28.9177
	80.00	8.39600	2.91689	.084	-2.5885	19.3805
	87.00	3.38400	5.50936	1.000	-17.4464	24.2144
	95.00	2.78400	2.61965	1.000	-7.8344	13.4024
	98.00	-9.64400	5.55151	1.000	-30.6348	11.3468
	108.00	-7.24000	5.52385	1.000	-28.1259	13.6459
	110.00	12.58000	5.09205	.979	-6.6631	31.8231
	112.00	1.57200	2.60004	1.000	-8.9727	12.1167
	119.00	-1.44800	5.70739	1.000	-23.0317	20.1357
	127.00	3.60800	2.69288	1.000	-7.0860	14.7020
51.00	10.00	-1.88400	7.28219	1.000	-29.2326	25.4646
	14.00	2.73200	5.60484	1.000	-18.4690	23.9330
	19.00	14.66800	7.02673	1.000	-11.8865	41.2225
	21.00	-4.01200	7.58865	1.000	-32.5905	24.5665
	29.00	4.19600	5.69052	1.000	-17.3163	25.7083
	31.00	18.40800	7.29255	.983	-9.0549	45.8709
	46.00	3.67200	5.64725	1.000	-17.6829	25.0269
	53.00	-4.81600	7.67811	1.000	-34.4860	24.8540
	61.00	-.38400	5.67886	1.000	-21.8539	21.0859
	63.00	12.07600	7.37613	1.000	-15.7012	39.8532
	66.00	-1.09200	7.54753	1.000	-29.5149	27.3309
	68.00	-.36400	5.59973	1.000	-21.5464	20.8184
	76.00	-1.12800	7.32814	1.000	-29.7623	26.5063
	78.00	13.33200	7.04106	1.000	-13.1862	39.8502
	80.00	12.06800	5.68715	1.000	-9.2593	33.4953
	87.00	7.05600	7.34584	1.000	-20.6073	34.7193
	95.00	6.46600	5.61772	1.000	-14.7917	27.7037
	98.00	-5.97200	7.37751	1.000	-33.7644	21.8104
	108.00	-3.56800	7.35679	1.000	-31.2725	24.1365
	110.00	16.25200	7.03829	.697	-10.2659	42.7699
	112.00	5.24400	5.60781	1.000	-15.9881	26.4561
	119.00	2.22400	7.49551	1.000	-26.0027	30.4507
	127.00	7.48000	5.65482	1.000	-13.9025	28.8625

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
53.00	10.00	2.93200	7.70092	1.000	-26.0737	31.9377
	14.00	7.54800	6.16271	1.000	-15.7744	30.8704
	19.00	19.68400	7.47929	.912	-9.4926	47.8606
	21.00	.80400	8.00971	1.000	-29.3602	30.9682
	29.00	9.01200	6.24074	1.000	-14.5931	32.6171
	31.00	23.22400	7.72958	.638	-5.8890	52.3370
	46.00	8.48800	6.20131	1.000	-14.9741	31.9501
	51.00	4.81600	7.67811	1.000	-24.8540	34.4860
	61.00	4.43200	6.23011	1.000	-19.1345	27.9985
	63.00	16.89200	7.60846	1.000	-12.5167	46.3007
	66.00	3.72400	7.97067	1.000	-26.2932	33.7412
	68.00	4.46200	6.15807	1.000	-18.8336	27.7576
	76.00	3.68800	7.77259	1.000	-25.5862	32.9622
	78.00	19.14800	7.49275	.989	-10.0789	48.3749
	80.00	16.88400	6.21944	.856	-6.6438	40.4118
	87.00	11.87200	7.77986	1.000	-17.4295	41.1735
	95.00	11.27200	6.17443	1.000	-12.0928	34.6368
	98.00	-1.16600	7.80977	1.000	-30.5898	28.2578
	108.00	1.24800	7.79020	1.000	-28.0923	30.5883
	110.00	21.06800	7.46014	.757	-7.1491	49.2851
	112.00	10.06000	6.16550	1.000	-13.2725	33.3925
	119.00	7.04000	7.92133	1.000	-22.7923	36.8723
	127.00	12.29600	6.20821	1.000	-11.1911	35.7831
61.00	10.00	-1.50000	5.43037	1.000	-22.0247	19.0247
	14.00	3.11600	2.85724	1.000	-7.6447	13.8767
	19.00	15.25200	5.11122	.569	-4.0586	34.5626
	21.00	-3.62800	5.68005	1.000	-25.7871	18.5311
	29.00	4.58000	3.02186	1.000	-6.7988	15.9588
	31.00	18.79200	5.47091	.168	-1.8869	39.4709
	46.00	4.05600	2.93957	1.000	-7.0140	15.1260
	51.00	.38400	5.67686	1.000	-21.0859	21.8539
	53.00	-4.43200	6.23011	1.000	-27.9985	19.1345
	63.00	12.46000	5.58183	.999	-8.6409	33.5609
	66.00	-.70800	5.60645	1.000	-22.6632	21.2472
	68.00	.02000	2.64721	1.000	-10.7031	10.7431
	76.00	-.74400	5.52154	1.000	-21.6535	20.1655
	78.00	13.71600	5.13090	.887	-5.6695	33.1015
	80.00	12.45200*	2.97762	.039	1.2389	23.6652
	87.00	7.44000	5.54175	1.000	-13.5083	28.3883
	95.00	6.84000	2.68244	.693	-4.0153	17.6953
	98.00	-5.58800	5.58366	1.000	-26.6959	15.5199
	108.00	-3.18400	5.56626	1.000	-24.1875	17.8195
	110.00	16.63600	5.12709	.300	-2.7350	36.0070
	112.00	5.62800	2.68326	1.000	-5.1553	16.4113
	119.00	2.60800	5.73866	1.000	-19.0894	24.3054
	127.00	7.56400	2.95409	.882	-3.2607	18.3887

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
63.00	10.00	-13.96000	7.18657	1.000	-41.0235	13.1035
	14.00	-9.34400	5.50651	1.000	-30.1710	11.4830
	19.00	2.79200	6.94855	1.000	-23.3771	28.9611
	21.00	-16.08800	7.51652	1.000	-44.3945	12.2185
	29.00	-7.88000	5.59369	1.000	-29.0240	13.2640
	31.00	6.33200	7.21725	1.000	-20.8470	33.5110
	46.00	-8.40400	5.54987	1.000	-29.3878	12.5798
	51.00	-12.07600	7.37613	1.000	-39.8532	15.7012
	53.00	-16.89200	7.60846	1.000	-46.3007	12.5167
	61.00	-12.46000	5.58183	.999	-33.5609	8.6409
	66.00	-13.16800	7.47480	1.000	-41.3172	14.9812
	68.00	-12.44000	5.50131	.999	-33.2481	8.3681
	76.00	-13.20400	7.26331	1.000	-40.5563	14.1483
	78.00	1.25600	6.96304	1.000	-24.9675	27.4795
	80.00	-.00800	5.56982	1.000	-21.0654	21.0494
	87.00	-5.02000	7.27109	1.000	-32.4018	22.3618
	95.00	-5.62000	5.51962	1.000	-26.4946	15.2546
	98.00	-18.04800	7.30309	.978	-45.5601	9.4641
	108.00	-15.64400	7.28215	1.000	-43.0673	11.7793
	110.00	4.17600	6.96023	1.000	-22.0370	30.3890
	112.00	-6.83200	5.50963	1.000	-27.6703	14.0063
	119.00	-9.85200	7.42227	1.000	-37.8031	18.0991
	127.00	-4.59600	5.55739	1.000	-25.6079	16.4159
66.00	10.00	-.79200	7.36239	1.000	-28.5187	26.9347
	14.00	3.62400	5.73407	1.000	-17.8684	25.1164
	19.00	15.96000	7.13024	.999	-10.8957	42.8157
	21.00	-2.92000	7.68479	1.000	-31.8595	26.0195
	29.00	5.28800	5.61785	1.000	-16.7086	27.2846
	31.00	19.50000	7.39234	.909	-8.3392	47.3392
	46.00	4.76400	5.77564	1.000	-17.0789	26.6069
	51.00	1.09200	7.54753	1.000	-27.3309	29.5149
	53.00	-3.72400	7.97067	1.000	-33.7412	26.2932
	61.00	.70800	5.60645	1.000	-21.2472	22.6632
	63.00	13.16800	7.47480	1.000	-14.9812	41.3172
	68.00	.72800	5.72909	1.000	-20.9464	22.4024
	76.00	-.03600	7.43732	1.000	-28.0443	27.9723
	78.00	14.42400	7.14436	1.000	-12.4846	41.3326
	80.00	13.16000	5.79500	.999	-8.7538	35.0738
	87.00	8.14800	7.44492	1.000	-19.8889	36.1849
	95.00	7.54800	5.74667	1.000	-14.1901	29.2861
	98.00	-4.88000	7.47616	1.000	-33.0343	23.2743
	108.00	-2.47600	7.45572	1.000	-30.5534	25.6014
	110.00	17.34400	7.14162	.987	-9.5544	44.2424
	112.00	6.83600	5.73707	1.000	-15.3673	29.0393
	119.00	3.31600	7.59283	1.000	-25.2765	31.9085
	127.00	8.57200	5.78284	1.000	-13.2978	30.4419

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
68.00	10.00	-1.52000	5.34756	1.000	-21.7434	18.7034
	14.00	3.09600	2.69654	1.000	-7.0687	13.2607
	19.00	15.23200	5.02315	.515	-3.7674	34.2214
	21.00	-3.64800	5.78340	1.000	-25.5289	18.2329
	29.00	4.56000	2.87039	1.000	-6.2506	15.3706
	31.00	19.77200	5.38873	.144	-1.6079	39.1519
	46.00	4.03600	2.78383	1.000	-6.4470	14.5190
	51.00	.36400	5.59973	1.000	-20.8184	21.5464
	53.00	-4.45200	6.15807	1.000	-27.7576	18.8536
	61.00	-.02000	2.84721	1.000	-10.7431	10.7031
	63.00	12.44000	5.50131	.999	-9.3681	33.2481
	66.00	-.72800	5.72608	1.000	-22.4024	20.9464
	76.00	-.76400	5.45027	1.000	-21.3780	19.8500
	78.00	13.69600	5.04318	.855	-5.3696	32.7616
	80.00	12.43200*	2.62378	.004	1.7974	23.0666
	87.00	7.42000	5.46063	1.000	-13.2334	28.0734
	95.00	6.82000	2.72322	.970	-3.4352	17.0752
	98.00	-5.60800	5.50316	1.000	-26.4232	15.2072
	108.00	-3.20400	5.47635	1.000	-23.9134	17.5054
	110.00	16.61600	5.03930	.258	-2.4349	35.6669
	112.00	5.60800	2.70281	1.000	-4.5707	15.7867
	119.00	2.58800	5.66037	1.000	-18.8250	24.0010
	127.00	7.64400	2.79896	.787	-2.6969	18.3849
76.00	10.00	-.75600	7.14757	1.000	-27.6728	26.1608
	14.00	3.86000	5.46552	1.000	-16.7731	24.4931
	19.00	15.99600	6.90821	.697	-10.0209	42.0129
	21.00	-2.88400	7.47924	1.000	-31.0504	25.2824
	29.00	5.32400	5.54251	1.000	-15.6291	26.2771
	31.00	19.53600	7.17842	.845	-7.4967	46.5687
	46.00	4.80000	5.49909	1.000	-15.9914	25.5914
	51.00	1.12800	7.32814	1.000	-26.5063	28.7623
	53.00	-3.68800	7.77259	1.000	-32.9622	25.5862
	61.00	.74400	5.53154	1.000	-20.1655	21.6535
	63.00	13.20400	7.26331	1.000	-14.1483	40.5563
	66.00	.03600	7.43732	1.000	-27.9723	28.0443
	68.00	.76400	5.45027	1.000	-19.8500	21.3780
	78.00	14.46000	6.92279	1.000	-11.6115	40.5315
	80.00	13.19600	5.51952	.992	-7.6697	34.0617
	87.00	8.18400	7.23256	1.000	-19.0625	35.4205
	95.00	7.58400	5.46875	1.000	-13.0971	28.2651
	98.00	-4.84400	7.26472	1.000	-32.2016	22.5136
	108.00	-2.44000	7.24267	1.000	-29.7184	24.8384
	110.00	17.38000	6.91998	.987	-8.6809	43.4409
	112.00	6.37200	5.45667	1.000	-14.2725	27.0165
	119.00	3.35200	7.38452	1.000	-24.4571	31.1611
	127.00	8.60800	5.50688	1.000	-12.2117	29.4277

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
78.00	10.00	-15.21600	6.64222	.999	-40.9835	10.5515
	14.00	-10.60000	5.04885	1.000	-29.6863	8.4863
	19.00	1.53600	6.89179	1.000	-23.2875	26.3595
	21.00	-17.34400	7.16800	.989	-44.4176	9.7296
	29.00	-9.13600	5.14380	1.000	-28.5686	10.2966
	31.00	5.07600	6.67444	1.000	-20.8130	30.9650
	46.00	-9.66000	5.09590	1.000	-28.9177	9.5977
	51.00	-13.33200	7.04106	1.000	-39.8502	13.1862
	53.00	-18.14800	7.49275	.989	-46.3749	10.0789
	61.00	-13.71600	5.13090	.887	-33.1015	5.6695
	63.00	-1.25600	6.96304	1.000	-27.4795	24.9675
	66.00	-14.42400	7.14439	1.000	-41.3326	12.4846
	68.00	-13.69600	5.04318	.855	-32.7616	5.3696
	76.00	-14.46000	6.92279	1.000	-40.5315	11.6115
	80.00	-1.26400	5.11794	1.000	-20.6022	18.0742
	87.00	-6.27600	6.93095	1.000	-32.3783	19.8263
	95.00	-6.87600	5.06315	1.000	-26.0143	12.2623
	98.00	-18.30400	6.96451	.799	-45.5330	6.9250
	108.00	-16.90000	6.94255	.986	-43.0482	9.2482
	110.00	2.92000	6.60410	1.000	-21.9498	27.7899
	112.00	-8.08800	5.06226	1.000	-27.1867	11.0107
	119.00	-11.10800	7.02939	1.000	-37.8088	15.5928
	127.00	-5.85200	5.10429	1.000	-25.1403	13.4363
80.00	10.00	-13.95200	5.41813	.945	-34.4320	6.5280
	14.00	-9.33600	2.83390	.253	-20.0086	1.3366
	19.00	2.80000	5.09821	1.000	-16.4631	22.0631
	21.00	-16.08000	5.64871	.826	-39.1979	6.0378
	29.00	-7.87200	2.99980	.916	-19.1689	3.4249
	31.00	6.34000	5.45876	1.000	-14.2946	26.9746
	46.00	-8.39600	2.91089	.884	-19.3805	2.5885
	51.00	-12.06800	5.66715	1.000	-33.4953	9.3593
	53.00	-16.88400	6.21944	.856	-40.4119	6.6439
	61.00	-12.45200*	2.97762	.009	-23.6652	-1.2389
	63.00	.00800	5.56992	1.000	-21.0494	21.0654
	66.00	-13.16000	5.79500	.989	-35.0736	8.7536
	68.00	-12.43200*	2.62378	.004	-23.0666	-1.7974
	76.00	-13.19600	5.51952	.992	-34.0617	7.6697
	78.00	1.26400	5.11794	1.000	-18.0742	20.6022
	87.00	-5.01200	5.52975	1.000	-25.9187	15.8927
	95.00	-5.61200	2.65929	1.000	-16.3800	5.1560
	98.00	-18.04000	5.57175	.307	-39.1044	3.0244
	108.00	-15.63600	5.54429	.755	-36.5959	5.3239
	110.00	4.18400	5.11411	1.000	-15.1388	23.5076
	112.00	-6.82400	2.63995	.980	-17.5193	3.8713
	119.00	-9.84400	5.72706	1.000	-31.4982	11.8112
	127.00	-4.58800	2.93152	1.000	-15.6276	6.4516

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
87.00	10.00	-8.94000	7.15548	1.000	-35.8864	18.0064
	14.00	-4.32400	5.46587	1.000	-24.9964	16.3484
	19.00	7.81200	8.91639	1.000	-18.2357	33.8597
	21.00	-11.06800	7.48680	1.000	-39.2628	17.1268
	29.00	-2.36000	5.56370	1.000	-23.8519	19.1319
	31.00	11.35200	7.18829	1.000	-15.7103	38.4143
	46.00	-3.38400	5.50938	1.000	-24.2144	17.4464
	51.00	-7.05600	7.34684	1.000	-34.7193	20.6073
	53.00	-11.87200	7.77986	1.000	-41.1735	17.4295
	61.00	-7.44000	5.54175	1.000	-28.3883	13.5083
	63.00	5.02000	7.27109	1.000	-22.3616	32.4016
	66.00	-8.14800	7.44492	1.000	-36.1849	19.8889
	68.00	-7.42000	5.46083	1.000	-28.0734	13.2334
	76.00	-8.18400	7.23256	1.000	-35.4205	19.0525
	78.00	6.27600	6.93095	1.000	-19.8263	32.3783
	80.00	5.01200	5.52975	1.000	-15.8927	25.9167
	95.00	-.60000	5.47909	1.000	-21.3204	20.1204
	98.00	-13.02800	7.27250	1.000	-40.4149	14.3589
	108.00	-10.62400	7.26149	1.000	-37.6317	16.3837
	110.00	9.19600	6.92813	1.000	-16.8957	35.2877
	112.00	-1.61200	5.46602	1.000	-22.4959	19.2719
	119.00	-4.83200	7.39217	1.000	-32.6699	23.0059
	127.00	.42400	5.51712	1.000	-20.4347	21.2827
95.00	10.00	-8.34000	5.36640	1.000	-28.6319	11.9519
	14.00	-3.72400	2.72371	1.000	-14.0187	6.5707
	19.00	8.41200	5.04320	1.000	-10.6505	27.4745
	21.00	-10.46800	5.60082	1.000	-32.4121	11.4761
	29.00	-2.26000	2.90634	1.000	-13.2018	8.6818
	31.00	11.95200	5.40742	1.000	-8.4959	32.3999
	46.00	-2.78400	2.61985	1.000	-13.4024	7.8344
	51.00	-6.45600	5.61772	1.000	-27.7037	14.7917
	53.00	-11.27200	6.17443	1.000	-34.6369	12.0929
	61.00	-6.84000	2.86244	.983	-17.6953	4.0153
	63.00	5.62000	5.51982	1.000	-15.2546	26.4946
	66.00	-7.54800	5.74687	1.000	-29.2861	14.1901
	68.00	-6.82000	2.72322	.970	-17.0752	3.4352
	76.00	-7.58400	5.46875	1.000	-28.2651	13.0971
	78.00	6.87600	5.06315	1.000	-12.2623	26.0143
	80.00	5.61200	2.65929	1.000	-5.1560	16.3800
	87.00	.60000	5.47909	1.000	-20.1204	21.3204
	98.00	-12.42800	5.52147	.999	-33.3096	8.4536
	108.00	-10.02400	5.49375	1.000	-30.8002	10.7522
	110.00	9.79600	5.06929	1.000	-9.3276	28.9196
	112.00	-1.21200	2.74000	1.000	-11.5303	9.1063
	119.00	-4.23200	5.67817	1.000	-25.7096	17.2456
	127.00	1.02400	2.63478	1.000	-9.8515	11.8995

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
98.00	10.00	4.08800	7.18799	1.000	-22.9809	31.1569
	14.00	8.70400	5.50836	1.000	-12.1300	29.5380
	19.00	20.84000	8.95002	.545	-5.3347	47.0147
	21.00	1.96000	7.51787	1.000	-26.3516	30.2716
	29.00	10.16800	5.59652	1.000	-10.9829	31.3189
	31.00	24.38000	7.21886	.198	-2.8043	51.5643
	46.00	9.64400	5.55151	1.000	-11.3468	30.6348
	51.00	5.97200	7.37751	1.000	-21.8104	33.7544
	53.00	1.15600	7.60977	1.000	-28.2578	30.5698
	61.00	6.58800	5.58368	1.000	-15.5199	28.6959
	63.00	19.04800	7.30209	.978	-9.4641	45.5601
	66.00	4.88000	7.47619	1.000	-23.2743	33.0343
	68.00	5.60800	5.50216	1.000	-15.2072	26.4232
	76.00	4.84400	7.26472	1.000	-22.5136	32.2016
	78.00	19.30400	6.98451	.788	-6.9250	45.5330
	80.00	18.04000	5.57175	.307	-3.0244	39.1044
	87.00	13.02800	7.27250	1.000	-14.3589	40.4149
	95.00	12.42800	5.52147	.999	-8.4536	33.3096
	108.00	2.40400	7.28355	1.000	-25.0245	29.8325
	110.00	22.22400	6.96169	.339	-3.9945	48.4425
	112.00	11.21600	5.51149	1.000	-9.6294	32.0614
	119.00	8.19600	7.42364	1.000	-19.7603	36.1523
	127.00	13.45200	5.55921	.989	-7.5669	34.4709
108.00	10.00	1.68400	7.16672	1.000	-25.3047	28.6727
	14.00	6.30000	5.48059	1.000	-14.4284	27.0284
	19.00	18.43600	6.92802	.892	-7.6559	44.5279
	21.00	-.44400	7.49754	1.000	-28.6792	27.7912
	29.00	7.76400	5.56817	1.000	-13.2829	28.8109
	31.00	21.97600	7.19749	.483	-5.1285	49.0805
	46.00	7.24000	5.52285	1.000	-13.6459	28.1259
	51.00	3.56800	7.35879	1.000	-24.1365	31.2725
	53.00	-1.24800	7.76020	1.000	-30.5883	28.0923
	61.00	3.18400	5.55626	1.000	-17.8195	24.1875
	63.00	15.64400	7.28215	1.000	-11.7793	43.0673
	66.00	2.47600	7.45572	1.000	-25.6014	30.5534
	68.00	3.20400	5.47535	1.000	-17.5054	23.9134
	76.00	2.44000	7.24387	1.000	-24.8384	29.7184
	78.00	16.90000	6.94255	.986	-9.2482	43.0482
	80.00	15.63600	5.54429	.755	-5.3239	36.5959
	87.00	10.62400	7.26149	1.000	-16.3837	37.6317
	95.00	10.02400	5.49375	1.000	-10.7522	30.8002
	98.00	-2.40400	7.28355	1.000	-29.8325	25.0245
	110.00	19.82000	6.93973	.710	-6.3156	45.9556
	112.00	9.01200	5.48072	1.000	-11.9279	29.9519
	119.00	5.79200	7.40305	1.000	-22.0869	33.6709
	127.00	11.04800	5.53169	1.000	-9.8661	31.9621

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
110.00	10.00	-18.13600	8.63936	.899	-43.8927	7.6207
	14.00	-13.52000	5.04497	.883	-32.6915	5.6515
	19.00	-1.38400	8.58882	1.000	-26.1963	23.4283
	21.00	-20.26400	7.18527	.749	-47.3274	6.7994
	29.00	-12.05600	5.14000	.696	-31.4742	7.3622
	31.00	2.15600	8.67159	1.000	-23.7223	28.0343
	46.00	-12.58000	5.09205	.979	-31.8231	6.6631
	51.00	-16.25200	7.03829	.997	-42.7598	10.2558
	53.00	-21.06800	7.49014	.757	-49.2851	7.1491
	61.00	-16.63600	5.12709	.200	-36.0070	2.7350
	63.00	-4.17600	8.96023	1.000	-30.3890	22.0370
	66.00	-17.34400	7.14162	.987	-44.2424	9.5544
	68.00	-16.61600	5.03930	.259	-35.6669	2.4349
	76.00	-17.38000	8.91998	.987	-43.4409	8.6809
	78.00	-2.92000	8.60410	1.000	-27.7899	21.9499
	80.00	-4.18400	5.11411	1.000	-23.5078	15.1398
	87.00	-9.19600	8.92813	1.000	-35.2877	16.8957
	95.00	-9.79600	5.06929	1.000	-28.9198	9.3278
	98.00	-22.22400	6.98169	.339	-48.4425	3.9945
	108.00	-19.82000	6.93973	.710	-45.9556	6.3156
	112.00	-11.00800	5.04839	1.000	-30.0919	8.0759
	119.00	-14.02800	7.08682	1.000	-40.7185	12.6625
	127.00	-8.77200	5.10045	1.000	-28.0457	10.5017
112.00	10.00	-7.12800	5.35613	1.000	-27.3825	13.1265
	14.00	-2.51200	2.71349	1.000	-12.7305	7.7065
	19.00	9.62400	5.03227	1.000	-9.3988	28.6468
	21.00	-9.25600	5.79132	1.000	-31.1656	12.6536
	29.00	-1.04800	2.88631	1.000	-11.9184	9.8224
	31.00	13.16400	5.39722	.986	-7.2469	33.5749
	46.00	-1.57200	2.60004	1.000	-12.1167	8.9727
	51.00	-5.24400	5.60791	1.000	-26.4561	15.9681
	53.00	-10.06000	6.16650	1.000	-33.3925	13.2725
	61.00	-5.62800	2.66326	1.000	-16.4113	5.1553
	63.00	6.83200	5.50983	1.000	-14.0063	27.6703
	66.00	-6.83600	5.73707	1.000	-29.0393	15.3673
	68.00	-5.60800	2.70291	1.000	-15.7867	4.5707
	76.00	-6.37200	5.45667	1.000	-27.0165	14.2725
	78.00	8.08800	5.05225	1.000	-11.0107	27.1867
	80.00	6.82400	2.63696	.690	-3.8713	17.5193
	87.00	1.31200	5.46902	1.000	-19.8719	22.4959
	95.00	1.21200	2.74000	1.000	-9.1063	11.5303
	98.00	-11.21600	5.51149	1.000	-32.0614	9.6294
	108.00	-8.81200	5.48372	1.000	-29.5519	11.9279
	110.00	11.00800	5.04839	1.000	-8.0759	30.0919
	119.00	-3.02000	5.66848	1.000	-24.4624	18.4224
	127.00	2.23600	2.61528	1.000	-8.3662	12.8382

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
119.00	10.00	-4.10800	7.30904	1.000	-31.6334	23.4174
	14.00	.50800	5.66542	1.000	-20.9234	21.9394
	19.00	12.64400	7.07515	1.000	-14.0035	39.2915
	21.00	-6.23600	7.63370	1.000	-34.9833	22.5113
	29.00	1.97200	5.75020	1.000	-19.7673	23.7113
	31.00	16.18400	7.33921	1.000	-11.4548	43.8228
	46.00	1.44800	5.70739	1.000	-20.1357	23.0317
	51.00	-2.22400	7.49551	1.000	-30.4507	26.0027
	53.00	-7.04000	7.92133	1.000	-36.8723	22.7923
	61.00	-2.60800	5.73866	1.000	-24.3054	19.0894
	63.00	9.85200	7.42227	1.000	-18.0991	37.8031
	66.00	-3.31600	7.59283	1.000	-31.9085	25.2765
	68.00	-2.58800	5.66037	1.000	-24.0010	18.8250
	76.00	-3.35200	7.38452	1.000	-31.1611	24.4571
	78.00	11.10800	7.08939	1.000	-15.5929	37.8089
	80.00	9.84400	5.72709	1.000	-11.8112	31.4992
	87.00	4.83200	7.39217	1.000	-23.0059	32.6699
	95.00	4.23200	5.67817	1.000	-17.2456	25.7096
	98.00	-8.19600	7.42364	1.000	-36.1523	19.7603
	108.00	-5.79200	7.40305	1.000	-33.6709	22.0869
	110.00	14.02800	7.08682	1.000	-12.6625	40.7185
	112.00	3.02000	5.66848	1.000	-18.4224	24.4624
	127.00	5.26600	5.71489	1.000	-16.3549	26.8869
127.00	10.00	-9.36400	5.40523	1.000	-29.7671	11.0391
	14.00	-4.74800	2.60918	1.000	-15.3272	5.8312
	19.00	7.38800	5.08450	1.000	-11.8251	26.6011
	21.00	-11.49200	5.63678	1.000	-33.5665	10.5825
	29.00	-3.28400	2.97644	1.000	-14.4929	7.9249
	31.00	10.92800	5.44598	1.000	-9.6600	31.5160
	46.00	-3.80800	2.69289	1.000	-14.7020	7.0860
	51.00	-7.48000	5.65482	1.000	-28.8625	13.9025
	53.00	-12.29600	6.20821	1.000	-35.7831	11.1911
	61.00	-7.86400	2.95409	.892	-18.9887	3.2607
	63.00	4.59600	5.55739	1.000	-16.4159	25.6079
	66.00	-8.57200	5.78294	1.000	-30.4419	13.2979
	68.00	-7.84400	2.79896	.767	-18.3849	2.6969
	76.00	-8.60800	5.50696	1.000	-29.4277	12.2117
	78.00	5.86200	5.10429	1.000	-13.4363	25.1603
	80.00	4.58800	2.93152	1.000	-6.4516	15.6276
	87.00	-.42400	5.51712	1.000	-21.2827	20.4347
	95.00	-1.02400	2.62479	1.000	-11.6995	9.6515
	98.00	-13.46200	5.55921	.989	-34.4709	7.5469
	108.00	-11.04800	5.53169	1.000	-31.9621	9.8661
	110.00	8.77200	5.10045	1.000	-10.5017	28.0457
	112.00	-2.23600	2.61528	1.000	-12.8382	8.3662
	119.00	-5.26600	5.71489	1.000	-26.8869	16.3549

K. TAMHANE'S T2 TEST LEVEL 5 (EFFORT)

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
7.00	12.00	-99.76000	53.26987	.999	-284.6311	87.0711
	23.00	-59.67200	69.62929	1.000	-302.2679	182.5239
	27.00	-209.75600*	53.07081	.010	-393.9425	-23.5695
	39.00	-8.17200	71.41839	1.000	-256.0727	239.7287
	44.00	-189.38800*	52.65819	.038	-373.8869	-4.9092
	59.00	-185.78400*	53.13943	.049	-371.2000	-.3680
	70.00	-171.86400	52.99566	.114	-356.8007	13.0727
	73.00	-100.54400	73.02059	1.000	-354.0021	152.9141
	74.00	-129.36800	69.76267	.999	-370.6541	113.8181
	85.00	-179.98400	53.55529	.077	-366.7880	6.8200
	102.00	-196.86000*	53.39757	.024	-383.1372	-10.5828
	106.00	-70.71600	71.74876	1.000	-319.7621	178.3301
	117.00	-172.44000	53.01080	.110	-357.4272	12.5472
12.00	7.00	99.76000	53.26987	.999	-87.0711	294.6311
	23.00	39.90800	48.60015	1.000	-130.6066	209.4226
	27.00	-109.97600*	17.38781	.000	-170.3319	-49.6201
	39.00	90.60800	50.85699	.999	-88.8023	269.0183
	44.00	-90.60800*	16.72823	.000	-148.6817	-32.5343
	59.00	-87.00400*	17.59674	.000	-149.0840	-25.9240
	70.00	-73.08400*	17.15770	.002	-132.6430	-13.5250
	73.00	-1.76400	53.08344	1.000	-186.9629	193.4349
	74.00	-29.58800	49.51203	1.000	-199.7979	139.6219
	85.00	-81.20400*	18.81530	.002	-146.5160	-15.8920
	102.00	-98.08000*	19.36156	.000	-161.8146	-34.3454
	106.00	29.06400	51.31989	1.000	-150.9659	207.0936
	117.00	-73.66000*	17.20439	.002	-133.3807	-13.9393
23.00	7.00	59.67200	69.62929	1.000	-182.5239	302.2679
	12.00	-39.90800	49.60015	1.000	-208.4226	130.6066
	27.00	-149.68400	48.38165	.189	-317.6689	19.9009
	39.00	51.70000	69.00649	1.000	-184.3575	287.7575
	44.00	-129.51600	49.14854	.500	-297.5232	38.4912
	59.00	-125.91200	49.45713	.594	-294.9489	43.1249
	70.00	-111.99200	49.29943	.857	-280.5025	56.5185
	73.00	-40.67200	69.68716	1.000	-282.6735	201.2295
	74.00	-68.49600	66.27189	1.000	-298.5290	161.5370
	85.00	-120.11200	48.91282	.739	-290.6721	50.4481
	102.00	-136.98800	49.74008	.383	-306.9703	32.9943
	106.00	-10.84400	68.35334	1.000	-248.1071	226.4191
	117.00	-112.56800	48.31603	.849	-281.1339	55.9979

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
27.00	7.00	209.75600*	53.07081	.010	23.5695	393.9425
	12.00	109.97600*	17.38781	.000	49.6201	170.3319
	23.00	149.68400	48.38165	.189	-19.9009	317.6689
	39.00	200.58400*	50.64823	.009	23.8704	377.2976
	44.00	19.36800	16.08239	1.000	-36.4575	75.1935
	59.00	22.97200	16.98396	1.000	-35.9804	81.9244
	70.00	36.89200	16.52865	.910	-20.4801	94.2641
	73.00	109.21200	52.68347	.979	-76.3200	292.7440
	74.00	80.38800	49.29414	1.000	-88.0907	248.8687
	85.00	28.77200	18.24350	1.000	-34.5620	92.1060
	102.00	11.89600	17.77517	1.000	-49.8074	73.5994
	106.00	139.04000	51.11202	.489	-40.2984	318.3784
	117.00	36.31600	16.57712	.931	-21.2242	93.8562
39.00	7.00	8.17200	71.41839	1.000	-239.7287	256.0727
	12.00	-90.60800	50.85699	.999	-269.0183	88.8023
	23.00	-51.70000	69.00648	1.000	-287.7575	184.3575
	27.00	-200.58400*	50.64823	.009	-377.2976	-23.8704
	44.00	-181.21600*	50.42560	.035	-357.1874	-5.2446
	59.00	-177.61200*	50.72034	.049	-354.5661	-.6579
	70.00	-163.69200	50.56969	.116	-340.1437	12.7597
	73.00	-92.37200	71.27945	1.000	-339.7899	155.0459
	74.00	-120.19600	67.94425	.999	-356.0379	115.6459
	85.00	-171.81200	51.16687	.079	-350.2209	6.5969
	102.00	-188.68800*	50.99073	.023	-366.5449	-10.8311
	106.00	-62.54400	69.97599	1.000	-305.4343	180.3463
	117.00	-164.26800	50.58656	.112	-340.7728	12.2368
44.00	7.00	189.38800*	52.65819	.039	4.9092	373.8869
	12.00	90.60800*	16.72823	.000	32.5343	149.6817
	23.00	129.51600	48.14854	.500	-38.4912	297.5232
	27.00	-19.36800	16.08239	1.000	-75.1935	36.4575
	39.00	181.21600*	50.42560	.035	5.2446	357.1874
	59.00	3.60400	16.30806	1.000	-53.0067	60.2147
	70.00	17.52400	15.63332	1.000	-37.4365	72.4835
	73.00	89.64400	52.67029	1.000	-94.9777	272.8657
	74.00	61.02000	49.06060	1.000	-106.6797	229.7197
	85.00	9.40400	17.61599	1.000	-51.7647	70.5727
	102.00	-7.47200	17.13051	1.000	-66.9476	52.0036
	106.00	118.67200	50.69242	.847	-58.9320	296.2760
	117.00	16.94800	15.68391	1.000	-38.1873	72.0833

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
59.00	7.00	185.78400*	53.13943	.049	.3680	371.2000
	12.00	87.00400*	17.59674	.000	25.9240	148.0840
	23.00	125.91200	48.45713	.594	-43.1249	294.9489
	27.00	-22.97200	16.98396	1.000	-81.9244	35.9804
	39.00	177.61200*	50.72034	.048	.6579	354.5681
	44.00	-3.60400	16.30806	1.000	-60.2147	53.0067
	70.00	13.92000	16.74830	1.000	-44.2153	72.0553
	73.00	85.24000	52.95254	1.000	-99.5223	270.0023
	74.00	57.41600	48.36975	1.000	-111.3152	226.1472
	85.00	5.60000	18.44274	1.000	-58.2228	69.8228
	102.00	-11.07600	17.97960	1.000	-73.4870	51.3350
	108.00	115.06800	51.18447	.803	-63.5097	293.6457
	117.00	13.34400	16.79613	1.000	-44.9571	71.6451
70.00	7.00	171.86400	52.99686	.114	-13.0727	356.8007
	12.00	73.08400*	17.16770	.002	13.5250	132.6430
	23.00	111.99200	49.29943	.857	-56.5185	280.5025
	27.00	-36.89200	16.52865	.910	-94.2641	20.4801
	39.00	163.69200	50.56969	.118	-12.7597	340.1437
	44.00	-17.52400	15.63332	1.000	-72.4835	37.4355
	59.00	-13.92000	16.74830	1.000	-72.0553	44.2153
	73.00	71.32000	52.60826	1.000	-112.9613	255.6013
	74.00	43.49600	48.21176	1.000	-124.7078	211.6999
	85.00	-8.12000	19.02431	1.000	-70.6970	54.4570
	102.00	-24.99600	17.56014	1.000	-85.9210	35.9290
	108.00	101.14800	51.03520	.989	-76.9319	279.2279
	117.00	-.57600	16.33559	1.000	-57.2777	56.1257
73.00	7.00	100.54400	73.02058	1.000	-152.9141	354.0021
	12.00	1.76400	53.08344	1.000	-183.4349	186.9629
	23.00	40.67200	69.68716	1.000	-201.2295	282.5735
	27.00	-108.21200	52.68347	.979	-292.7440	76.3200
	39.00	92.37200	71.27945	1.000	-155.0469	339.7889
	44.00	-88.64400	52.67029	1.000	-272.6657	94.9777
	59.00	-85.24000	52.95254	1.000	-270.0023	99.5223
	70.00	-71.32000	52.60826	1.000	-255.6013	112.9613
	74.00	-27.62400	69.62643	1.000	-269.5152	213.8672
	85.00	-79.44000	53.36985	1.000	-265.5952	106.7152
	102.00	-96.31600	53.21158	.999	-281.9426	89.3108
	108.00	29.82800	71.61045	1.000	-218.7375	278.3935
	117.00	-71.89600	52.82345	1.000	-256.2279	112.4359

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
74.00	7.00	128.36800	69.76887	.998	-113.8181	370.5541
	12.00	29.58800	48.51303	1.000	-139.6218	198.7978
	23.00	68.49600	66.27189	1.000	-161.5370	298.5290
	27.00	-80.38800	48.29414	1.000	-248.8667	88.0907
	39.00	120.19600	67.94425	.999	-115.6458	356.0378
	44.00	-61.02000	48.06060	1.000	-229.7197	106.6797
	59.00	-57.41600	48.36975	1.000	-226.1472	111.3152
	70.00	-43.49600	48.21176	1.000	-211.6999	124.7078
	73.00	27.62400	69.62643	1.000	-213.8672	269.5152
	85.00	-51.61600	48.62625	1.000	-221.8732	118.6412
	102.00	-68.49200	48.65321	1.000	-238.1703	101.1863
	108.00	57.65200	69.29143	1.000	-179.3985	294.7005
	117.00	-44.07200	49.22840	1.000	-212.3313	124.1873
85.00	7.00	179.98400	53.55629	.077	-6.8200	366.7880
	12.00	81.20400*	19.81530	.002	15.8920	146.5160
	23.00	120.11200	49.91282	.739	-50.4481	290.6721
	27.00	-28.77200	18.24350	1.000	-92.1080	34.5620
	39.00	171.61200	51.15687	.078	-6.5969	350.2209
	44.00	-9.40400	17.61699	1.000	-70.5727	51.7647
	59.00	-5.60000	18.44274	1.000	-69.8228	58.2228
	70.00	8.12000	19.02431	1.000	-54.4570	70.6970
	73.00	79.44000	53.36985	1.000	-106.7152	265.5952
	74.00	51.61600	48.62625	1.000	-118.6412	221.8732
	102.00	-16.87600	19.17384	1.000	-83.4303	49.6783
	108.00	109.26800	51.61609	.961	-70.7512	289.2872
	117.00	7.54400	19.06877	1.000	-55.1865	70.2745
102.00	7.00	196.86000*	53.39767	.024	10.5828	383.1372
	12.00	98.08000*	18.36156	.000	34.3454	161.8146
	23.00	136.98800	49.74008	.383	-32.9943	306.9703
	27.00	-11.89600	17.77517	1.000	-73.5994	49.8074
	39.00	188.68800*	50.99073	.023	10.8311	366.5449
	44.00	7.47200	17.13051	1.000	-52.0036	66.9476
	59.00	11.07600	17.97960	1.000	-51.3350	73.4870
	70.00	24.99600	17.56014	1.000	-35.9290	85.9210
	73.00	96.31600	53.21158	.999	-89.3108	281.9426
	74.00	68.49200	48.65321	1.000	-101.1863	238.1703
	85.00	16.87600	19.17384	1.000	-49.6783	83.4303
	108.00	126.14400	51.45242	.743	-53.3282	305.6162
	117.00	24.42000	17.59679	1.000	-36.6629	85.5029

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
106.00	7.00	70.71600	71.74876	1.000	-178.3301	319.7621
	12.00	-28.06400	51.31989	1.000	-207.0936	150.9656
	23.00	10.64400	68.35334	1.000	-226.4191	248.1071
	27.00	-138.04000	51.11302	.489	-316.3794	40.2994
	39.00	62.54400	69.97599	1.000	-180.3463	305.4343
	44.00	-119.67200	50.69242	.847	-298.2760	58.9320
	59.00	-115.06800	51.18447	.903	-293.6457	63.5097
	70.00	-101.14800	51.02520	.989	-279.2279	76.9319
	73.00	-29.62800	71.61045	1.000	-278.3935	218.7375
	74.00	-57.65200	68.29143	1.000	-294.7005	179.3985
	86.00	-109.26800	51.61609	.961	-289.2872	70.7512
	102.00	-126.14400	51.46242	.743	-305.6162	53.3282
	117.00	-101.72400	51.05092	.988	-279.8563	76.4083
117.00	7.00	172.44000	53.01080	.110	-12.5472	357.4272
	12.00	73.66000*	17.20439	.002	13.9393	133.3807
	23.00	112.56800	48.31603	.849	-55.9979	281.1339
	27.00	-36.31600	16.57712	.931	-93.8562	21.2242
	39.00	164.26800	50.58556	.112	-12.2366	340.7726
	44.00	-16.94800	15.68391	1.000	-72.0833	38.1873
	59.00	-13.34400	16.79613	1.000	-71.6451	44.9571
	70.00	.57600	16.33559	1.000	-56.1257	57.2777
	73.00	71.89600	52.62345	1.000	-112.4359	256.2279
	74.00	44.07200	48.22840	1.000	-124.1873	212.3313
	86.00	-7.54400	18.06877	1.000	-70.2745	55.1865
	102.00	-24.42000	17.59579	1.000	-85.5029	36.6629
	106.00	101.72400	51.05092	.988	-76.4083	279.8563

L. TAMHANE'S T2 TEST FOR LEVEL 6 (EFFORT)

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
16.00	20.00	-132.62000*	31.43977	.016	-256.8366	-8.8034
	22.00	-325.28400*	31.36680	.000	-449.0086	-201.5594
	25.00	-230.02000*	33.62951	.000	-362.6992	-97.3408
	26.00	-310.52400*	31.47689	.000	-434.6864	-186.3616
	28.00	-282.61200*	28.19833	.000	-393.8789	-171.3451
	32.00	-95.18400	31.12692	.733	-217.9617	27.5937
	36.00	-191.64400*	32.19948	.000	-318.6626	-64.6254
	38.00	-184.26400*	31.77446	.000	-309.6026	-58.9254
	48.00	-55.40400	30.91287	1.000	-177.3411	66.5331
	52.00	-297.68400*	30.26381	.000	-417.2628	-178.6052
	54.00	-284.97600*	31.69232	.000	-410.7804	-159.1716
	57.00	-213.22000*	31.92895	.000	-339.1691	-87.2709
	58.00	-331.69200*	32.17602	.000	-458.8178	-204.9682
	60.00	-313.68000*	26.68664	.000	-419.0481	-208.3119
	64.00	-162.03600*	29.07469	.000	-276.7385	-47.3335
	72.00	-140.21200*	32.25959	.009	-267.4683	-12.9557
	81.00	-208.12000*	31.75433	.000	-333.3791	-82.8609
	82.00	-404.99200*	31.95432	.000	-531.0414	-278.9426
	86.00	-386.19600*	28.55626	.000	-498.8649	-273.6271
	88.00	-263.40800*	30.57232	.000	-384.0023	-142.8137
	91.00	-262.16800*	31.91173	.000	-388.0491	-136.2869
	92.00	-397.88400*	32.40832	.000	-525.7285	-270.0395
	93.00	-132.71600*	31.47117	.016	-256.8566	-8.5754
	94.00	-223.40000*	30.34707	.000	-343.1067	-103.6933
	104.00	-175.76000*	32.14664	.000	-302.5697	-48.9503
	113.00	-319.60400*	31.68461	.000	-444.7877	-194.8203
	114.00	-409.76000*	32.61435	.000	-538.4196	-281.1004
	118.00	-352.62000*	26.76570	.000	-458.2956	-246.9444
	120.00	-319.71200*	31.37460	.000	-443.4713	-195.9527
	123.00	-197.73200*	31.69289	.000	-323.5386	-71.9254
	124.00	-340.62800*	30.76685	.000	-461.9885	-219.2675
	125.00	-98.87200	30.54208	.515	-219.3471	21.6031
	126.00	-186.53600*	30.63593	.000	-307.3810	-65.6910

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
20.00	16.00	132.62000*	31.43977	.016	8.8034	256.8366
	22.00	-192.46400*	31.68217	.000	-318.2246	-66.7034
	25.00	-97.20000	34.11163	.923	-231.7714	37.3714
	26.00	-177.70400*	31.99127	.000	-303.8949	-51.5131
	28.00	-149.79200*	28.77160	.000	-263.3339	-36.2502
	32.00	37.63600	31.64621	1.000	-87.1942	162.4662
	36.00	-59.02400	32.70269	1.000	-189.0233	69.9753
	38.00	-51.44400	32.28429	1.000	-178.7912	75.9032
	48.00	77.41600	31.43669	1.000	-46.5885	201.4205
	52.00	-165.06400*	30.79867	.000	-286.5565	-43.5715
	54.00	-152.15600*	32.40029	.002	-279.9611	-24.3509
	57.00	-80.40000	32.43635	1.000	-208.3475	47.5475
	58.00	-199.07200*	32.67959	.000	-327.9801	-70.1639
	60.00	-180.66000*	27.29168	.000	-289.6353	-73.0847
	64.00	-29.21600	29.63102	1.000	-146.1224	87.6904
	72.00	-7.39200	32.76187	1.000	-136.6251	121.8411
	81.00	-75.30000	32.26449	1.000	-202.5690	51.9690
	82.00	-272.17200*	32.46133	.000	-400.2181	-144.1259
	86.00	-253.37600*	29.12249	.000	-368.2903	-138.4617
	88.00	-130.58800*	31.10187	.018	-253.2737	-7.9023
	91.00	-129.34800*	32.41941	.042	-257.2286	-1.4674
	92.00	-265.06400*	32.90634	.000	-394.8758	-135.2522
	93.00	.10400	31.98584	1.000	-126.0655	126.2735
	94.00	-90.58000	30.68049	.861	-212.3944	31.2344
	104.00	-42.94000	32.65066	1.000	-171.7339	85.8539
	113.00	-186.98400*	32.19587	.000	-313.9822	-59.9858
	114.00	-276.94000*	33.11126	.000	-407.5538	-146.3262
	118.00	-219.80000*	27.38900	.000	-327.8756	-111.7244
	120.00	-186.69200*	31.69083	.000	-312.6867	-61.0973
	123.00	-64.91200	32.40086	1.000	-192.7194	62.8954
	124.00	-207.80800*	31.29281	.000	-331.2461	-84.3699
	125.00	33.94800	31.07214	1.000	-88.6207	156.5167
	126.00	-53.71600	31.16439	1.000	-176.6479	69.2159

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
22.00	16.00	325.28400*	31.36580	.000	201.5594	449.0086
	20.00	192.46400*	31.68217	.000	66.7034	318.2246
	25.00	95.26400	34.04347	.950	-39.0397	229.5677
	26.00	14.76000	31.91858	1.000	-111.1442	140.6642
	28.00	42.67200	28.69076	1.000	-70.5489	155.8929
	32.00	230.10000*	31.57273	.000	105.5598	354.6402
	36.00	133.44000*	32.63159	.029	4.7207	262.1593
	38.00	141.02000*	32.21226	.008	13.9567	268.0833
	48.00	269.68000*	31.36271	.000	146.1676	393.5924
	52.00	27.40000	30.72316	1.000	-93.7940	148.5940
	54.00	40.30800	32.32853	1.000	-87.2143	167.8303
	57.00	112.06400	32.36486	.278	-15.6010	239.7290
	58.00	-6.60800	32.60843	1.000	-135.2359	122.0199
	60.00	11.60400	27.20644	1.000	-95.8321	119.0401
	64.00	163.24800*	29.55253	.000	46.6527	279.8433
	72.00	185.07200*	32.69080	.000	56.1184	314.0256
	81.00	117.16400	32.19242	.156	-9.8209	244.1489
	82.00	-79.70800	32.38970	1.000	-207.4719	49.0559
	86.00	-60.91200	29.04262	1.000	-175.5095	53.6855
	88.00	61.87600	31.02709	1.000	-60.5143	184.2663
	91.00	63.11600	32.34769	1.000	-64.4820	190.7140
	92.00	-72.60000	32.83768	1.000	-202.1337	56.9337
	93.00	192.56800*	31.91314	.000	66.6852	318.4508
	94.00	101.68400	30.60517	.433	-19.6327	223.4007
	104.00	149.52400*	32.57945	.003	21.0107	278.0373
	113.00	5.48000	32.12385	1.000	-121.2335	132.1935
	114.00	-84.47600	33.04103	.998	-214.8135	45.8615
	118.00	-27.33600	27.28400	1.000	-135.0734	80.4014
	120.00	5.57200	31.61791	1.000	-119.9351	131.0791
	123.00	127.55200*	32.32909	.050	.0275	255.0765
	124.00	-15.34400	31.21880	1.000	-139.4886	107.8006
	125.00	226.41200*	30.99730	.000	104.1390	348.6850
	126.00	139.74800*	31.08977	.006	16.1109	261.3851

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
25.00	16.00	230.02000*	33.62951	.000	97.3408	362.6992
	20.00	97.20000	34.11163	.923	-37.3714	231.7714
	22.00	-95.26400	34.04347	.950	-229.5677	39.0397
	26.00	-80.50400	34.14687	1.000	-215.2091	54.2011
	28.00	-52.59200	31.14946	1.000	-175.5838	70.3998
	32.00	134.83600*	33.82259	.042	1.3993	268.2727
	36.00	38.17600	34.61309	1.000	-99.1525	175.5045
	38.00	45.75600	34.42035	1.000	-90.0283	181.5403
	48.00	174.61600*	33.62683	.000	41.9481	307.2839
	52.00	-67.86400	33.03094	1.000	-198.1976	62.4696
	54.00	-54.95600	34.52918	1.000	-191.1680	81.2560
	57.00	16.80000	34.56302	1.000	-119.5451	153.1451
	58.00	-101.87200	34.79139	.885	-239.1152	35.3712
	60.00	-83.66000	29.78793	.947	-201.3757	34.0557
	64.00	67.98400	31.94499	1.000	-58.1057	194.0737
	72.00	89.60800	34.86889	.997	-47.7393	227.3553
	81.00	21.90000	34.40179	1.000	-113.8113	157.6113
	82.00	-174.97200*	34.58646	.000	-311.4092	-38.5348
	86.00	-156.17600*	31.47387	.001	-280.4298	-31.9222
	88.00	-33.38800	33.31383	1.000	-164.8297	98.0537
	91.00	-32.14800	34.54712	1.000	-168.4306	104.1346
	92.00	-167.86400*	35.00834	.001	-305.9529	-29.7751
	93.00	97.30400	34.14058	.923	-37.3811	231.9891
	94.00	6.62000	33.10723	1.000	-124.0124	137.2524
	104.00	54.26000	34.76422	1.000	-82.8763	191.3963
	113.00	-89.78400	34.33743	.994	-225.2424	45.6744
	114.00	-179.74000*	35.19716	.000	-318.5801	-40.8999
	118.00	-122.60000*	29.85879	.027	-240.5893	-4.6107
	120.00	-89.69200	34.05159	.993	-224.0276	44.6436
	123.00	32.28800	34.52971	1.000	-103.9261	168.5021
	124.00	-110.60800	33.49226	.439	-242.7490	21.5330
	125.00	131.14800	33.28609	.051	-.1849	262.4809
	126.00	43.48400	33.37221	1.000	-88.1865	175.1545

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
26.00	16.00	310.52400*	31.47689	.000	186.3616	434.6864
	20.00	177.70400*	31.99127	.000	51.5131	303.8949
	22.00	-14.76000	31.91858	1.000	-140.6642	111.1442
	25.00	80.50400	34.14587	1.000	-54.2011	215.2091
	28.00	27.91200	28.81194	1.000	-85.7899	141.6139
	32.00	215.34000*	31.68289	.000	90.3650	340.3150
	36.00	118.68000	32.73819	.164	-10.4591	247.8191
	38.00	126.26000	32.32025	.059	-1.2289	253.7489
	48.00	255.12000*	31.47361	.000	130.9697	379.2703
	52.00	12.64000	30.83635	1.000	-109.0015	134.2815
	54.00	25.54800	32.43612	1.000	-102.3983	153.4943
	57.00	97.30400	32.47214	.800	-30.7845	225.3925
	58.00	-21.36800	32.71511	1.000	-150.4160	107.6800
	60.00	-3.16600	27.33421	1.000	-111.1006	104.7686
	64.00	148.48800*	29.67019	.000	31.4264	265.5496
	72.00	170.31200*	32.79730	.000	40.9394	299.6846
	81.00	102.40400	32.30047	.596	-25.0069	229.8148
	82.00	-94.46800	32.49709	.883	-222.6550	33.7190
	86.00	-75.67200	29.16234	.996	-190.7444	39.4004
	88.00	47.11600	31.13919	1.000	-75.7172	169.9492
	91.00	49.35600	32.45622	1.000	-79.6657	178.3777
	92.00	-87.36000	32.94361	.990	-217.3107	42.5907
	93.00	177.80800*	32.02213	.000	51.4953	304.1207
	94.00	87.12400	30.91807	.941	-34.8390	209.0870
	104.00	134.76400*	32.68622	.024	5.8301	263.6979
	113.00	-9.28000	32.23193	1.000	-136.4204	117.8604
	114.00	-99.23600	33.14632	.803	-229.9878	31.5159
	118.00	-42.09600	27.41140	1.000	-150.3403	66.1483
	120.00	-9.18800	31.92723	1.000	-135.1263	116.7503
	123.00	112.79200	32.43669	.286	-15.1566	240.7406
	124.00	-30.10400	31.33001	1.000	-153.6886	93.4806
	125.00	211.65200*	31.10950	.000	88.9356	334.3684
	126.00	123.98800*	31.20164	.045	.9089	247.0671

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
28.00	16.00	282.61200*	28.19833	.000	171.3451	393.8789
	20.00	149.79200*	28.77180	.000	36.2502	263.3338
	22.00	-42.67200	28.69076	1.000	-155.8929	70.5489
	25.00	52.59200	31.14949	1.000	-70.3998	175.5838
	26.00	-27.91200	28.81194	1.000	-141.6139	85.7899
	32.00	187.42800*	28.42831	.000	75.2486	299.6074
	36.00	90.76800	29.59987	.724	-26.0632	207.5992
	38.00	98.34800	29.13695	.361	-16.6444	213.3404
	48.00	227.20800*	28.19489	.000	115.9547	338.4613
	52.00	-15.27200	27.48171	1.000	-123.6976	93.1536
	54.00	-2.36400	29.26543	1.000	-117.8667	113.1387
	57.00	69.39200	29.30535	1.000	-46.2692	185.0532
	58.00	-49.28000	29.57435	1.000	-166.0098	67.4499
	60.00	-31.06800	23.48452	1.000	-123.7209	61.5849
	64.00	120.57600*	26.16646	.003	17.3567	223.7953
	72.00	142.40000*	29.66524	.001	25.3091	259.4909
	81.00	74.49200	29.11601	.998	-40.4132	189.3972
	82.00	-122.38000*	29.33300	.020	-238.1510	-6.6090
	86.00	-103.58400*	25.58917	.033	-204.5224	-2.6456
	88.00	19.20400	27.82109	1.000	-90.5669	128.9749
	91.00	20.44400	29.28660	1.000	-95.1427	136.0307
	92.00	-115.27200	29.82692	.069	-233.0053	2.4613
	93.00	149.69600*	28.80591	.000	36.2180	263.5740
	94.00	59.21200	27.57337	1.000	-49.5768	168.0008
	104.00	106.85200	29.54238	.169	-9.7508	223.4548
	113.00	-37.19200	29.03895	1.000	-151.7962	77.4112
	114.00	-127.14800*	30.05065	.016	-245.7705	-8.5255
	118.00	-70.00800	23.57432	.828	-163.0133	22.9973
	120.00	-37.10000	28.70037	1.000	-150.3591	76.1591
	123.00	84.68000	29.26606	.889	-30.6251	200.3851
	124.00	-58.01600	28.03449	1.000	-169.6331	52.6011
	125.00	183.74000*	27.78785	.000	74.1010	293.3790
	126.00	96.07600	27.69096	.295	-13.9719	206.1239

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
32.00	16.00	95.18400	31.12582	.733	-27.5937	217.9617
	20.00	-37.63600	31.64621	1.000	-162.4662	87.1942
	22.00	-230.10000*	31.57273	.000	-354.6402	-105.5598
	25.00	-134.83600*	33.62259	.042	-268.2727	-1.3993
	26.00	-215.34000*	31.68289	.000	-340.3150	-90.3650
	28.00	-187.42800*	28.42831	.000	-299.6074	-75.2486
	36.00	-96.66000	32.40109	.814	-224.4719	31.1519
	38.00	-89.08000	31.97874	.956	-215.2231	37.0631
	48.00	39.78000	31.12281	1.000	-82.9854	162.5454
	52.00	-202.70000*	30.47822	.000	-322.9258	-82.4742
	54.00	-189.79200*	32.09585	.000	-316.3977	-63.1863
	57.00	-119.03600	32.13224	.139	-244.7855	6.7135
	58.00	-236.70800*	32.37776	.000	-364.4277	-108.9883
	60.00	-218.49600*	26.92954	.000	-324.8304	-112.1616
	64.00	-66.85200	29.29780	1.000	-182.4381	48.7341
	72.00	-45.02800	32.46081	1.000	-173.0760	83.0200
	81.00	-112.93600	31.95874	.222	-239.0002	13.1282
	82.00	-309.80800*	32.15746	.000	-436.6571	-182.9589
	86.00	-291.01200*	28.78339	.000	-404.5814	-177.4426
	88.00	-169.22400*	30.78459	.000	-289.6584	-46.7916
	91.00	-166.98400*	32.11514	.000	-293.6659	-40.3021
	92.00	-302.70000*	32.60863	.000	-431.3323	-174.0677
	93.00	-37.53200	31.67741	1.000	-162.4853	87.4213
	94.00	-128.21600*	30.56089	.018	-248.7673	-7.6647
	104.00	-80.57600	32.34857	.999	-208.1803	47.0283
	113.00	-224.62000*	31.88947	.000	-350.4106	-98.8294
	114.00	-314.57600*	32.81340	.000	-444.0181	-185.1339
	118.00	-257.43600*	27.00789	.000	-364.0750	-150.7970
	120.00	-224.52800*	31.58147	.000	-349.1027	-99.9533
	123.00	-102.54800	32.09642	.566	-229.1560	24.0600
	124.00	-245.44400*	30.97759	.000	-367.6369	-123.2511
	125.00	-3.68800	30.75455	1.000	-125.0021	117.6261
	126.00	-91.35200	30.64775	.835	-213.0333	30.3293

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
36.00	16.00	191.84400*	32.19948	.000	64.8254	318.8626
	20.00	59.02400	32.70269	1.000	-69.9753	188.0233
	22.00	-133.44000*	32.63159	.028	-262.1593	-4.7207
	25.00	-38.17600	34.61309	1.000	-175.5045	99.1525
	26.00	-118.68000	32.73819	.164	-247.8191	10.4591
	28.00	-90.76800	29.59987	.724	-207.5992	26.0632
	32.00	96.66000	32.40109	.814	-31.1519	224.4719
	38.00	7.58000	33.02459	1.000	-122.6875	137.8475
	48.00	136.44000*	32.19647	.015	9.4332	263.4469
	52.00	-106.04000	31.57381	.378	-230.5993	18.5193
	54.00	-93.13200	33.13800	.945	-223.8466	37.6826
	57.00	-21.37600	33.17325	1.000	-152.2296	109.4776
	58.00	-140.04800*	33.41112	.018	-271.8396	-8.2564
	60.00	-121.83600*	28.16352	.011	-233.0817	-10.5903
	64.00	29.80800	30.43591	1.000	-90.2900	149.9060
	72.00	51.63200	33.49181	1.000	-80.4771	183.7411
	81.00	-16.27600	33.00522	1.000	-146.4672	113.9152
	82.00	-213.14800*	33.19768	.000	-344.0979	-82.1981
	86.00	-194.35200*	29.94106	.000	-312.5151	-76.1889
	88.00	-71.56400	31.86984	1.000	-197.2856	54.1576
	91.00	-70.32400	33.15669	1.000	-201.1123	60.4643
	92.00	-206.04000*	33.63490	.000	-338.7144	-73.3656
	93.00	59.12800	32.73288	1.000	-69.9902	188.2462
	94.00	-31.55600	31.65362	1.000	-156.4289	93.3169
	104.00	16.08400	33.38283	1.000	-115.6960	147.7640
	113.00	-127.96000	32.93815	.063	-257.8869	1.9669
	114.00	-217.91600*	33.83346	.000	-351.3741	-84.4579
	118.00	-160.77600*	28.22844	.000	-272.3121	-49.2399
	120.00	-127.86800	32.64004	.056	-256.6208	.8846
	123.00	-5.88800	33.13865	1.000	-136.6048	124.8288
	124.00	-148.78400*	32.05611	.002	-275.2387	-22.3293
	125.00	92.97200	31.64063	.872	-32.6356	218.5796
	126.00	5.30800	31.93086	1.000	-120.6535	131.2695

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
38.00	16.00	184.28400*	31.77446	.000	58.9254	309.6026
	20.00	51.44400	32.28429	1.000	-75.9032	178.7912
	22.00	-141.02000*	32.21226	.008	-268.0833	-13.9567
	25.00	-45.75600	34.42035	1.000	-181.5403	90.0283
	26.00	-126.26000	32.32025	.059	-253.7489	1.2289
	28.00	-98.34800	29.13695	.381	-213.3404	16.6444
	32.00	89.08000	31.97874	.956	-37.0631	215.2231
	36.00	-7.58000	33.02458	1.000	-137.8475	122.6875
	48.00	128.86000*	31.77140	.032	3.5334	254.1866
	52.00	-113.62000	31.14024	.151	-236.4635	9.2235
	54.00	-100.71200	32.72516	.710	-229.7978	28.3739
	57.00	-28.95600	32.76086	1.000	-158.1827	100.2707
	58.00	-147.62800*	33.00170	.005	-277.8052	-17.4508
	60.00	-129.41600*	27.67659	.002	-238.7232	-20.1088
	64.00	22.22800	29.98580	1.000	-96.0852	140.5412
	72.00	44.06200	33.08319	1.000	-86.4469	174.5509
	81.00	-23.85600	32.59071	1.000	-152.4114	104.6994
	82.00	-220.72800*	32.78559	.000	-350.0523	-91.4037
	86.00	-201.93200*	29.48349	.000	-318.2787	-85.5853
	88.00	-79.14400	31.44015	.999	-203.1669	44.8789
	91.00	-77.90400	32.74409	1.000	-207.0645	51.2565
	92.00	-213.62000*	33.22823	.000	-344.6916	-82.5484
	93.00	51.54800	32.31487	1.000	-75.9197	179.0157
	94.00	-39.13600	31.22116	1.000	-162.2976	84.0256
	104.00	8.50400	32.97306	1.000	-121.5601	138.5681
	113.00	-135.54000*	32.52276	.020	-263.8275	-7.2525
	114.00	-225.49600*	33.42921	.000	-357.3615	-93.6305
	118.00	-168.35600*	27.75282	.000	-277.9590	-58.7530
	120.00	-135.44800*	32.22083	.017	-262.5450	-8.3510
	123.00	-13.46800	32.72572	1.000	-142.5560	115.6200
	124.00	-156.36400*	31.62915	.001	-281.1306	-31.5974
	125.00	85.39200	31.41074	.978	-38.5152	209.2992
	126.00	-2.27200	31.50201	1.000	-126.5382	121.9942

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
48.00	16.00	55.40400	30.91287	1.000	-66.5331	177.3411
	20.00	-77.41600	31.43669	1.000	-201.4205	46.5885
	22.00	-269.88000*	31.36271	.000	-393.5924	-146.1676
	25.00	-174.61600*	33.62663	.000	-307.2839	-41.9481
	26.00	-255.12000*	31.47361	.000	-379.2703	-130.9697
	28.00	-227.20800*	28.19489	.000	-339.4613	-115.9547
	32.00	-39.78000	31.12281	1.000	-162.5454	82.9854
	36.00	-136.44000*	32.19647	.015	-263.4469	-9.4332
	38.00	-128.86000*	31.77140	.032	-254.1866	-3.5334
	52.00	-242.48000*	30.26081	.000	-361.8461	-123.1139
	54.00	-229.57200*	31.88927	.000	-355.3644	-103.7796
	57.00	-157.81600*	31.92581	.001	-283.7532	-31.8788
	58.00	-276.48800*	32.17300	.000	-403.4020	-149.5740
	60.00	-258.27600*	26.68300	.000	-363.6297	-152.9223
	64.00	-106.63200	29.07136	.141	-221.3213	8.0573
	72.00	-84.80800	32.25659	.993	-212.0524	42.4364
	81.00	-152.71600*	31.75128	.001	-277.9631	-27.4689
	82.00	-349.58800*	31.95129	.000	-475.6255	-223.5505
	86.00	-330.79200*	28.55286	.000	-443.4474	-218.1366
	88.00	-208.00400*	30.56915	.000	-328.5859	-87.4222
	91.00	-206.76400*	31.90870	.000	-332.6331	-80.8949
	92.00	-342.48000*	32.40533	.000	-470.3127	-214.6473
	93.00	-77.31200	31.46809	1.000	-201.4405	46.8165
	94.00	-167.99600*	30.34387	.000	-287.6901	-48.3019
	104.00	-120.35600	32.14362	.107	-247.1539	6.4419
	113.00	-264.40000*	31.68155	.000	-389.3716	-139.4284
	114.00	-354.35600*	32.61139	.000	-483.0039	-225.7081
	118.00	-297.21600*	26.76209	.000	-402.8772	-191.5548
	120.00	-264.30800*	31.37151	.000	-389.0551	-140.6609
	123.00	-142.32800*	31.68985	.006	-269.1227	-16.5333
	124.00	-285.22400*	30.76350	.000	-406.6720	-163.8760
	125.00	-43.46800	30.53880	1.000	-163.9306	76.9946
	126.00	-131.13200*	30.63276	.012	-251.9645	-10.2995

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
52.00	16.00	297.68400*	30.26381	.000	178.6052	417.2828
	20.00	165.06400*	30.79867	.000	43.5715	286.5565
	22.00	-27.40000	30.72316	1.000	-148.5940	93.7940
	25.00	67.86400	33.03084	1.000	-62.4698	198.1976
	26.00	-12.64000	30.63635	1.000	-134.2815	109.0015
	28.00	15.27200	27.48171	1.000	-93.1536	123.6976
	32.00	202.70000*	30.47822	.000	82.4742	322.9259
	36.00	106.04000	31.57381	.378	-18.5183	230.5983
	38.00	113.62000	31.14024	.151	-9.2235	236.4635
	48.00	242.48000*	30.26081	.000	123.1139	361.8461
	54.00	12.90800	31.26049	1.000	-110.4112	136.2272
	57.00	84.66400	31.29786	.981	-38.8031	208.1311
	58.00	-34.00800	31.54985	1.000	-158.4726	90.4586
	60.00	-15.79600	25.92827	1.000	-118.1486	86.5566
	64.00	135.84800*	28.38021	.001	23.8940	247.8020
	72.00	157.67200*	31.63510	.000	32.8700	282.4740
	81.00	89.76400	31.11971	.900	-32.9982	212.5262
	82.00	-107.10800	31.32375	.317	-230.6776	16.4616
	86.00	-88.31200	27.64885	.586	-198.1782	21.5542
	88.00	34.47600	29.91263	1.000	-83.5161	152.4681
	91.00	35.71600	31.28031	1.000	-87.6816	159.1136
	92.00	-100.00000	31.78676	.627	-225.4025	25.4025
	93.00	165.16800*	30.62072	.000	43.5489	286.7872
	94.00	74.48400	29.68237	.989	-42.5994	191.5674
	104.00	122.12400	31.51982	.086	-2.2220	246.4700
	113.00	-21.92000	31.04857	1.000	-144.4008	100.5608
	114.00	-111.67600	31.99679	.251	-238.1104	14.3584
	118.00	-54.73600	26.00964	1.000	-157.4057	47.9337
	120.00	-21.82800	30.73214	1.000	-143.0575	99.4015
	123.00	100.15200	31.26109	.556	-23.1696	223.4736
	124.00	-42.74400	30.11122	1.000	-161.5201	76.0321
	125.00	199.01200*	29.88172	.000	81.1419	316.8821
	126.00	111.34800	29.97784	.119	-6.9007	229.5967

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
54.00	16.00	284.97600*	31.69232	.000	159.1716	410.7804
	20.00	152.15600*	32.40029	.002	24.3509	279.9611
	22.00	-40.30800	32.32853	1.000	-167.8303	87.2143
	25.00	54.95600	34.52919	1.000	-81.2560	191.1680
	26.00	-25.54800	32.43612	1.000	-153.4943	102.3983
	28.00	2.36400	29.26543	1.000	-113.1387	117.8667
	32.00	189.79200*	32.09585	.000	63.1863	316.3977
	36.00	93.13200	33.13800	.945	-37.5826	223.8466
	38.00	100.71200	32.72516	.710	-28.3738	229.7978
	48.00	229.57200*	31.68927	.000	103.7796	355.3644
	52.00	-12.90800	31.26049	1.000	-136.2272	110.4112
	57.00	71.75600	32.67519	1.000	-57.9216	201.4336
	58.00	-46.91600	33.11520	1.000	-177.5406	83.7086
	60.00	-28.70400	27.61181	1.000	-138.5495	81.1415
	64.00	122.94000*	30.11076	.029	4.1317	241.7483
	72.00	144.76400*	33.19640	.009	13.8189	275.7091
	81.00	76.85600	32.70582	1.000	-52.1528	205.8648
	82.00	-120.01600	32.89983	.151	-249.7909	9.7589
	86.00	-101.22000	29.61047	.319	-218.0707	15.6307
	88.00	21.56800	31.55926	1.000	-102.9259	146.0619
	91.00	22.80800	32.85847	1.000	-106.8036	152.4196
	92.00	-112.90800	33.34096	.349	-244.4238	18.6078
	93.00	152.26000*	32.43077	.002	24.3348	280.1852
	94.00	61.57600	31.34110	1.000	-62.0601	185.2121
	104.00	109.21600	33.08665	.440	-21.2959	239.7279
	113.00	-34.82800	32.63794	1.000	-163.5699	93.9139
	114.00	-124.78400	33.54126	.117	-257.0909	7.5229
	118.00	-67.64400	27.68769	1.000	-177.7839	42.4959
	120.00	-34.73600	32.33706	1.000	-162.2919	92.8199
	123.00	87.24400	32.64017	.990	-42.2954	216.7834
	124.00	-55.65200	31.74755	1.000	-180.8866	69.5826
	125.00	186.10400*	31.52998	.000	61.7254	310.4826
	126.00	98.44000	31.62088	.887	-26.2962	223.1762

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
57.00	16.00	213.22000*	31.92895	.000	87.2709	339.1691
	20.00	80.40000	32.43635	1.000	-47.5475	208.3475
	22.00	-112.06400	32.36466	.278	-239.7290	15.6010
	25.00	-16.80000	34.56302	1.000	-153.1451	119.5451
	26.00	-97.30400	32.47214	.800	-225.3925	30.7845
	28.00	-69.39200	29.30635	1.000	-185.0532	46.2692
	32.00	118.03600	32.13224	.138	-9.7135	244.7855
	36.00	21.37600	33.17325	1.000	-109.4776	152.2296
	38.00	28.95600	32.76086	1.000	-100.2707	158.1827
	48.00	157.81600*	31.92591	.001	31.8789	283.7532
	52.00	-84.66400	31.29786	.981	-208.1311	38.8031
	54.00	-71.75600	32.67519	1.000	-201.4336	57.9216
	58.00	-118.67200	33.15049	.191	-249.4357	12.0917
	60.00	-100.46000	27.65381	.177	-210.4727	9.5527
	64.00	51.18400	30.14956	1.000	-67.7782	170.1462
	72.00	73.00800	33.23159	1.000	-58.0758	204.0918
	81.00	5.10000	32.74134	1.000	-124.0497	134.2497
	82.00	-191.77200*	32.93534	.000	-321.6868	-61.8572
	86.00	-172.97600*	29.64992	.000	-289.9833	-55.9687
	88.00	-50.18800	31.59627	1.000	-174.8282	74.4522
	91.00	-48.94800	32.89402	1.000	-178.6989	80.8039
	92.00	-184.66400*	33.37600	.000	-316.3179	-53.0101
	93.00	80.50400	32.46679	1.000	-47.5634	208.5714
	94.00	-10.18000	31.37839	1.000	-133.9635	113.6035
	104.00	37.46000	33.12186	1.000	-93.1912	168.1112
	113.00	-106.58400	32.67373	.485	-235.4671	22.2991
	114.00	-196.54000*	33.57609	.000	-328.9840	-64.0960
	118.00	-139.40000*	27.92957	.000	-249.7065	-29.0935
	120.00	-106.49200	32.37319	.453	-234.1906	21.2066
	123.00	15.48800	32.87574	1.000	-114.1918	145.1678
	124.00	-127.40800*	31.78435	.039	-252.7881	-2.0279
	125.00	114.34800	31.56702	.165	-10.1772	238.8732
	126.00	26.68400	31.65782	1.000	-98.1983	151.5663

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
58.00	16.00	331.89200*	32.17602	.000	204.9662	458.8178
	20.00	199.07200*	32.67959	.000	70.1639	327.9801
	22.00	6.60800	32.60843	1.000	-122.0199	135.2358
	25.00	101.87200	34.79139	.885	-35.3712	239.1152
	26.00	21.36800	32.71511	1.000	-107.6800	150.4160
	28.00	49.28000	29.57435	1.000	-67.4489	166.0088
	32.00	236.70800*	32.37776	.000	108.9883	364.4277
	36.00	140.04800*	33.41112	.018	8.2564	271.8396
	38.00	147.62800*	33.00170	.005	17.4509	277.8052
	48.00	276.48800*	32.17300	.000	149.5740	403.4020
	52.00	34.00800	31.54989	1.000	-90.4586	158.4726
	54.00	46.91600	33.11520	1.000	-83.7086	177.5406
	57.00	118.67200	33.15049	.191	-12.0917	249.4357
	60.00	18.21200	28.13669	1.000	-92.9269	129.3509
	64.00	169.85600*	30.41109	.000	49.8565	289.8555
	72.00	191.68000*	33.46905	.000	59.6599	323.7001
	81.00	123.77200	32.98233	.104	-6.3289	253.8729
	82.00	-73.10000	33.17492	1.000	-203.9600	57.7600
	86.00	-54.30400	29.91582	1.000	-172.3669	63.7589
	88.00	68.48400	31.84593	1.000	-57.1439	194.1118
	91.00	69.72400	33.13390	1.000	-60.9743	200.4223
	92.00	-65.99200	33.61243	1.000	-198.5779	66.5939
	93.00	199.17600*	32.70980	.000	70.1489	328.2031
	94.00	108.49200	31.62975	.307	-16.2863	233.2703
	104.00	156.13200*	33.36020	.002	24.5413	287.7227
	113.00	12.08800	32.91521	1.000	-117.7483	141.9243
	114.00	-77.86800	33.81113	1.000	-211.2381	55.5021
	118.00	-20.72800	28.21189	1.000	-132.1575	90.7015
	120.00	12.18000	32.61690	1.000	-116.4812	140.8412
	123.00	134.16000*	33.11675	.033	3.5332	264.7869
	124.00	-8.73600	32.03254	1.000	-135.0975	117.6255
	125.00	233.02000*	31.61690	.000	107.5063	358.5337
	126.00	145.35600*	31.90700	.004	19.4881	271.2239

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
60.00	16.00	313.68000*	26.68684	.000	208.3119	419.0481
	20.00	180.86000*	27.29188	.000	73.0847	288.6353
	22.00	-11.60400	27.20644	1.000	-119.0401	95.8321
	25.00	83.66000	29.78793	.947	-34.0557	201.3757
	26.00	3.15600	27.33421	1.000	-104.7886	111.1006
	28.00	31.06800	23.48452	1.000	-61.5849	123.7209
	32.00	218.49600*	26.92954	.000	112.1616	324.8304
	36.00	121.83600*	28.16352	.011	10.5903	233.0817
	38.00	129.41600*	27.67659	.002	20.1088	238.7232
	48.00	258.27600*	26.68300	.000	152.9223	363.6297
	52.00	15.79600	25.92827	1.000	-86.5566	118.1486
	54.00	28.70400	27.61181	1.000	-81.1415	138.5495
	57.00	100.46000	27.65381	.177	-9.5527	210.4727
	58.00	-18.21200	28.13669	1.000	-129.3509	92.9268
	64.00	151.64400*	24.52988	.000	54.8459	248.4422
	72.00	173.46800*	28.23221	.000	61.9489	284.9872
	81.00	105.56000	27.65347	.083	-3.6552	214.7752
	82.00	-91.31200	27.68289	.473	-201.4404	18.8164
	86.00	-72.51600	23.91311	.762	-166.8676	21.8356
	88.00	50.27200	26.28771	1.000	-53.5096	154.0536
	91.00	51.51200	27.63408	1.000	-58.4221	161.4461
	92.00	-84.20400	28.40204	.834	-196.3994	27.9914
	93.00	180.96400*	27.32785	.000	73.0447	288.8833
	94.00	90.28000	26.02540	.275	-12.4587	193.0187
	104.00	137.92000*	28.10309	.001	26.9149	248.9251
	113.00	-6.12400	27.57339	1.000	-115.0205	102.7725
	114.00	-96.08000	28.63691	.385	-209.2107	17.0507
	118.00	-38.94000	21.74360	1.000	-124.7082	46.8282
	120.00	-6.03200	27.21659	1.000	-113.5085	101.4445
	123.00	115.94800*	27.61247	.021	6.0999	225.7961
	124.00	-26.94800	26.51347	1.000	-131.6274	77.7314
	125.00	214.80800*	26.25253	.000	111.1663	318.4497
	126.00	127.14400*	26.36166	.001	23.0684	231.2196

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
64.00	16.00	162.03600*	29.07469	.000	47.3335	276.7385
	20.00	29.21600	29.63102	1.000	-87.6904	146.1224
	22.00	-163.24800*	29.56253	.000	-279.8433	-46.6527
	25.00	-67.98400	31.94499	1.000	-194.0737	58.1057
	26.00	-148.48800*	29.67019	.000	-265.5496	-31.4264
	28.00	-120.57600*	26.16646	.003	-223.7953	-17.3567
	32.00	66.85200	29.29780	1.000	-48.7341	182.4381
	36.00	-29.80800	30.43581	1.000	-149.9060	90.2900
	38.00	-22.22800	29.98590	1.000	-140.5412	96.0852
	48.00	106.63200	29.07136	.141	-8.0573	221.3213
	52.00	-135.84800*	28.38021	.001	-247.8020	-23.8940
	54.00	-122.94000*	30.11076	.029	-241.7483	-4.1317
	57.00	-51.18400	30.14956	1.000	-170.1462	67.7782
	58.00	-169.85600*	30.41109	.000	-289.8555	-49.8565
	60.00	-151.64400*	24.52988	.000	-248.4422	-54.8459
	72.00	21.82400	30.49949	1.000	-98.5263	142.1743
	81.00	-46.08400	29.96459	1.000	-164.3126	72.1446
	82.00	-242.95600*	30.17643	.000	-362.0247	-123.8873
	86.00	-224.16000*	26.55180	.000	-328.8963	-119.4237
	88.00	-101.37200	29.70897	.224	-214.6267	11.8827
	91.00	-100.13200	30.13133	.416	-219.0219	18.7579
	92.00	-235.84800*	30.65677	.000	-356.8223	-114.8737
	93.00	29.32000	29.66434	1.000	-87.7184	146.3584
	94.00	-61.36400	28.46699	1.000	-173.6691	50.9411
	104.00	-13.72400	30.38000	1.000	-133.6002	106.1522
	113.00	-157.76800*	29.69069	.000	-275.7037	-39.8323
	114.00	-247.72400*	30.67449	.000	-369.5624	-125.8856
	118.00	-190.58400*	24.61687	.000	-287.7186	-93.4494
	120.00	-157.67600*	29.56186	.000	-274.3083	-41.0437
	123.00	-35.69600	30.11137	1.000	-154.5067	83.1147
	124.00	-178.59200*	29.91583	.000	-292.6655	-64.5185
	125.00	63.16400	28.67676	1.000	-49.9632	176.2912
	126.00	-24.50000	28.77669	1.000	-139.0227	89.0227

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
72.00	16.00	140.21200*	32.25959	.009	12.9557	267.4683
	20.00	7.39200	32.76187	1.000	-121.8411	136.6251
	22.00	-185.07200*	32.69090	.000	-314.0256	-56.1184
	25.00	-89.80800	34.86889	.997	-227.3553	47.7393
	26.00	-170.31200*	32.79730	.000	-299.6846	-40.9394
	28.00	-142.40000*	29.66524	.001	-259.4909	-25.3091
	32.00	45.02800	32.46081	1.000	-83.0200	173.0760
	36.00	-51.63200	33.49161	1.000	-183.7411	80.4771
	38.00	-44.05200	33.08319	1.000	-174.5509	86.4469
	48.00	84.80800	32.25659	.993	-42.4364	212.0524
	52.00	-157.67200*	31.63510	.000	-282.4740	-32.8700
	54.00	-144.76400*	33.19640	.009	-275.7091	-13.8189
	57.00	-73.00800	33.23159	1.000	-204.0918	58.0758
	58.00	-191.68000*	33.46905	.000	-323.7001	-59.6599
	60.00	-173.46800*	28.23221	.000	-284.9872	-61.9488
	64.00	-21.62400	30.49949	1.000	-142.1743	98.9263
	81.00	-67.90800	33.06386	1.000	-198.3307	62.5147
	82.00	-264.78000*	33.25698	.000	-395.9599	-133.6001
	86.00	-245.98400*	30.00569	.000	-364.4037	-127.5643
	88.00	-123.19600	31.93036	.070	-249.1579	2.7659
	91.00	-121.95600	33.21606	.139	-252.9746	9.0626
	92.00	-257.67200*	33.69244	.000	-390.5733	-124.7707
	93.00	7.49600	32.79201	1.000	-121.8558	136.8478
	94.00	-83.18800	31.71476	.994	-208.3028	41.9268
	104.00	-35.54800	33.44081	1.000	-167.4567	96.3607
	113.00	-179.59200*	32.99691	.000	-309.7509	-49.4331
	114.00	-269.54800*	33.59066	.000	-403.2316	-135.8644
	118.00	-212.40800*	28.30696	.000	-324.2169	-100.5992
	120.00	-179.50000*	32.69934	.000	-308.4869	-50.5131
	123.00	-57.52000	33.19695	1.000	-188.4673	73.4273
	124.00	-200.41600*	32.11648	.000	-327.1095	-73.7225
	125.00	41.34000	31.90141	1.000	-84.5081	167.1881
	126.00	-46.32400	31.99127	1.000	-172.5253	79.8773

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
81.00	16.00	208.12000*	31.75433	.000	82.8609	333.3791
	20.00	75.30000	32.26449	1.000	-51.9690	202.5690
	22.00	-117.16400	32.19242	.156	-244.1489	9.8209
	25.00	-21.90000	34.40179	1.000	-157.6113	113.8113
	26.00	-102.40400	32.30047	.596	-229.8149	25.0069
	28.00	-74.49200	29.11501	.999	-189.3972	40.4132
	32.00	112.93600	31.95874	.222	-13.1282	239.0002
	36.00	16.27600	33.00522	1.000	-113.9152	146.4672
	38.00	23.86600	32.59071	1.000	-104.6994	152.4114
	48.00	152.71600*	31.75129	.001	27.4689	277.9631
	52.00	-89.76400	31.11971	.900	-212.5262	32.9982
	54.00	-76.86600	32.70562	1.000	-205.8849	52.1529
	57.00	-5.10000	32.74134	1.000	-134.2497	124.0497
	58.00	-123.77200	32.98233	.104	-253.8729	6.3289
	60.00	-105.56000	27.66347	.083	-214.7752	3.6552
	64.00	46.08400	29.96459	1.000	-72.1446	164.3126
	72.00	67.90800	33.06386	1.000	-62.5147	198.3307
	82.00	-196.87200*	32.76609	.000	-326.1194	-67.6246
	86.00	-178.07600*	29.46181	.000	-294.3366	-61.8154
	88.00	-55.28800	31.41981	1.000	-179.2305	68.6545
	91.00	-54.04800	32.72456	1.000	-183.1315	75.0355
	92.00	-189.76400*	33.20899	.000	-320.7598	-58.7682
	93.00	75.40400	32.29609	1.000	-51.9856	202.7936
	94.00	-15.28000	31.20089	1.000	-138.3608	107.8008
	104.00	32.36000	32.95367	1.000	-97.6277	162.3477
	113.00	-111.68400	32.50312	.302	-239.8939	16.5259
	114.00	-201.64000*	33.41009	.000	-333.4302	-69.8498
	118.00	-144.50000*	27.72978	.000	-254.0113	-34.9887
	120.00	-111.59200	32.20099	.276	-238.6107	15.4267
	123.00	10.38800	32.70619	1.000	-119.6230	139.3990
	124.00	-132.50800*	31.60894	.018	-257.1947	-7.8213
	125.00	109.24800	31.39039	.284	-14.5787	233.0747
	126.00	21.58400	31.48171	1.000	-102.6020	145.7700

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
82.00	16.00	404.99200*	31.95432	.000	278.9426	531.0414
	20.00	272.17200*	32.46133	.000	144.1259	400.2181
	22.00	79.70800	32.38970	1.000	-48.0559	207.4719
	25.00	174.97200*	34.58646	.000	38.5348	311.4092
	26.00	94.46800	32.49709	.883	-33.7190	222.6550
	28.00	122.38000*	29.33300	.020	6.6090	238.1510
	32.00	309.60800*	32.15746	.000	182.9589	436.6571
	36.00	213.14800*	33.19765	.000	82.1981	344.0979
	38.00	220.72800*	32.78659	.000	91.4037	350.0523
	48.00	349.58800*	31.95129	.000	223.5505	475.6255
	52.00	107.10800	31.32375	.317	-16.4616	230.6776
	54.00	120.01600	32.69983	.151	-9.7589	249.7909
	57.00	191.77200*	32.93534	.000	61.8572	321.6869
	58.00	73.10000	33.17492	1.000	-57.7600	203.9600
	60.00	91.31200	27.68289	.473	-18.8164	201.4404
	64.00	242.95600*	30.17643	.000	123.8873	362.0247
	72.00	264.78000*	33.25698	.000	133.6001	395.9599
	81.00	196.87200*	32.76609	.000	67.6246	326.1194
	86.00	18.79600	29.67725	1.000	-98.3197	135.9117
	88.00	141.58400*	31.62192	.005	16.8423	266.3257
	91.00	142.62400*	32.91888	.010	12.9750	272.6730
	92.00	7.10800	33.40027	1.000	-124.6415	138.8575
	93.00	272.27600*	32.49175	.000	144.1100	400.4420
	94.00	181.59200*	31.40420	.000	57.7063	305.4777
	104.00	229.23200*	33.14642	.000	98.4844	359.9796
	113.00	85.18800	32.69853	.995	-43.7930	214.1690
	114.00	-4.76800	33.60022	1.000	-137.3071	127.7711
	118.00	52.37200	27.96857	1.000	-58.0499	162.7939
	120.00	85.28000	32.39822	.993	-42.5174	213.0774
	123.00	207.26000*	32.90039	.000	77.4830	337.0370
	124.00	64.36400	31.60984	1.000	-61.1169	189.8449
	125.00	306.12000*	31.59289	.000	181.4933	430.7467
	126.00	218.45600*	31.68242	.000	93.4725	343.4395

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
86.00	16.00	386.19600*	28.55626	.000	273.5271	498.8649
	20.00	253.37600*	29.12249	.000	138.4617	368.2903
	22.00	60.91200	29.04262	1.000	-53.6855	175.5095
	25.00	156.17600*	31.47387	.001	31.9222	280.4298
	26.00	75.67200	29.16234	.996	-39.4004	190.7444
	28.00	103.58400*	25.58917	.033	2.6456	204.5224
	32.00	291.01200*	28.78339	.000	177.4426	404.5814
	36.00	194.35200*	29.94106	.000	76.1889	312.5151
	38.00	201.93200*	29.48349	.000	85.5853	318.2787
	48.00	330.79200*	28.55286	.000	218.1366	443.4474
	52.00	88.31200	27.64885	.596	-21.5542	198.1782
	54.00	101.22000	29.61047	.319	-15.6307	218.0707
	57.00	172.97600*	29.64992	.000	55.9687	289.9833
	58.00	54.30400	29.91582	1.000	-63.7589	172.3669
	60.00	72.51600	23.91311	.762	-21.8356	166.8676
	64.00	224.16000*	26.55180	.000	119.4237	328.8963
	72.00	245.98400*	30.00569	.000	127.5643	364.4037
	81.00	178.07600*	29.46181	.000	61.8154	294.3366
	82.00	-18.79600	29.67725	1.000	-135.9117	98.3197
	88.00	122.78800*	28.18381	.009	11.5952	233.9809
	91.00	124.02800*	29.63139	.019	7.0943	240.9617
	92.00	-11.68800	30.16554	1.000	-130.7425	107.3665
	93.00	253.48000*	29.15639	.000	138.4312	368.5289
	94.00	162.79600*	27.93931	.000	52.5716	273.0204
	104.00	210.43600*	29.68422	.000	92.4986	329.3734
	113.00	66.39200	29.38665	1.000	-49.5704	182.3544
	114.00	-23.56400	30.38678	1.000	-143.4973	96.3693
	118.00	33.57600	24.00131	1.000	-61.1213	128.2733
	120.00	66.48400	29.05212	1.000	-48.1511	181.1191
	123.00	188.46400*	29.61109	.000	71.6109	305.3171
	124.00	45.56800	28.39449	1.000	-66.4597	157.5957
	125.00	287.32400*	28.15100	.000	176.2611	398.3869
	126.00	199.66000*	28.25279	.000	88.1939	311.1262

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
88.00	16.00	263.40800*	30.57232	.000	142.8137	384.0023
	20.00	130.58800*	31.10187	.019	7.9023	253.2737
	22.00	-61.88600	31.02709	1.000	-184.2863	60.5143
	25.00	33.38800	33.31283	1.000	-98.0537	164.8297
	26.00	-47.11600	31.13919	1.000	-169.9492	75.7172
	28.00	-19.20400	27.62109	1.000	-128.9749	90.5669
	32.00	169.22400*	30.78459	.000	48.7916	289.6564
	36.00	71.56400	31.56984	1.000	-54.1576	197.2856
	38.00	79.14400	31.44015	.999	-44.8789	203.1669
	48.00	208.00400*	30.56915	.000	87.4222	328.5858
	52.00	-34.47600	29.91263	1.000	-152.4681	83.5161
	54.00	-21.56800	31.55926	1.000	-146.0619	102.9259
	57.00	50.18800	31.59627	1.000	-74.4522	174.8282
	58.00	-68.48400	31.64593	1.000	-194.1118	57.1438
	60.00	-50.27200	26.28771	1.000	-154.0536	53.5096
	64.00	101.37200	29.70897	.224	-11.8827	214.6267
	72.00	123.19600	31.93036	.070	-2.7659	249.1579
	81.00	55.28800	31.41981	1.000	-68.6545	179.2305
	82.00	-141.58400*	31.62192	.005	-266.3257	-16.8423
	86.00	-122.78800*	28.18381	.009	-233.9808	-11.5952
	91.00	1.24000	31.57889	1.000	-123.3315	125.8115
	92.00	-134.47600*	32.08062	.019	-261.0325	-7.9195
	93.00	130.69200*	31.13361	.018	7.8809	253.5032
	94.00	40.00800	29.99686	1.000	-78.3161	158.3321
	104.00	87.64800	31.61624	.969	-37.8624	213.1584
	113.00	-56.39600	31.34935	1.000	-180.0599	67.2679
	114.00	-146.35200*	32.28874	.004	-273.7324	-18.9716
	118.00	-89.21200	26.36797	.354	-193.3061	14.8821
	120.00	-56.30400	31.03599	1.000	-178.7294	66.1214
	123.00	65.67600	31.55984	1.000	-59.8202	190.1722
	124.00	-77.22000	30.42129	.998	-197.2182	42.7782
	125.00	164.53600*	30.19413	.000	45.4340	283.6380
	126.00	76.87200	30.28909	.998	-42.6045	196.3485

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
91.00	16.00	262.16800*	31.91173	.000	136.2869	388.0491
	20.00	129.34800*	32.41941	.042	1.4674	257.2286
	22.00	-63.11600	32.34769	1.000	-190.7140	64.4820
	25.00	32.14800	34.54712	1.000	-104.1346	168.4306
	26.00	-48.35600	32.46522	1.000	-176.3777	79.6657
	28.00	-20.44400	29.28660	1.000	-136.0307	95.1427
	32.00	166.98400*	32.11514	.000	40.3021	293.6659
	36.00	70.32400	33.16669	1.000	-60.4643	201.1123
	38.00	77.90400	32.74409	1.000	-51.2565	207.0645
	48.00	206.76400*	31.90870	.000	80.8949	332.6331
	52.00	-35.71600	31.28031	1.000	-159.1136	87.6816
	54.00	-22.80800	32.65847	1.000	-152.4196	106.8036
	57.00	48.94800	32.69402	1.000	-80.8039	178.6999
	58.00	-69.72400	33.13380	1.000	-200.4223	60.9743
	60.00	-51.51200	27.63409	1.000	-161.4461	58.4221
	64.00	100.13200	30.13133	.416	-18.7579	219.0219
	72.00	121.95600	33.21506	.139	-9.0626	252.9746
	81.00	54.04800	32.72456	1.000	-75.0355	183.1315
	82.00	-142.82400*	32.91866	.010	-272.6730	-12.9750
	86.00	-124.02800*	29.63139	.019	-240.9617	-7.0943
	88.00	-1.24000	31.57889	1.000	-125.8115	123.3315
	92.00	-135.71600*	33.35953	.030	-267.3050	-4.1270
	93.00	129.45200*	32.44987	.042	1.4514	257.4526
	94.00	38.76800	31.36086	1.000	-84.9462	162.4822
	104.00	86.40800	33.10637	.995	-44.1777	216.9937
	113.00	-57.63600	32.65691	1.000	-186.4529	71.1809
	114.00	-147.59200*	33.55972	.007	-279.9715	-15.2125
	118.00	-90.45200	27.90989	.514	-200.6802	19.7762
	120.00	-57.54400	32.35621	1.000	-185.1756	70.0876
	123.00	64.43600	32.66903	1.000	-65.1778	194.0498
	124.00	-78.46000	31.76706	1.000	-203.7717	46.8517
	125.00	163.29600*	31.54961	.000	38.8397	287.7523
	126.00	75.63200	31.64047	1.000	-49.1817	200.4457

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
92.00	16.00	397.88400*	32.40832	.000	270.0395	525.7285
	20.00	265.06400*	32.90834	.000	135.2522	394.8758
	22.00	72.60000	32.63769	1.000	-56.9337	202.1337
	25.00	167.86400*	35.00634	.001	29.7751	305.9529
	26.00	87.36000	32.94361	.980	-42.5907	217.3107
	28.00	115.27200	29.82892	.069	-2.4613	233.0053
	32.00	302.70000*	32.60863	.000	174.0677	431.3323
	36.00	206.04000*	33.63490	.000	73.3656	338.7144
	38.00	213.62000*	33.22823	.000	82.5484	344.6916
	48.00	342.48000*	32.40533	.000	214.6473	470.3127
	52.00	100.00000	31.78876	.627	-25.4025	225.4025
	54.00	112.90800	33.34086	.349	-18.6078	244.4238
	57.00	184.66400*	33.37600	.000	53.0101	316.3179
	58.00	65.99200	33.61243	1.000	-66.5939	198.5779
	60.00	84.20400	28.40204	.834	-27.9914	196.3994
	64.00	235.84800*	30.65677	.000	114.8737	356.8223
	72.00	257.67200*	33.69244	.000	124.7707	390.5733
	81.00	189.76400*	33.20899	.000	58.7682	320.7598
	82.00	-7.10800	33.40027	1.000	-139.8575	124.6415
	86.00	11.68800	30.16554	1.000	-107.3665	130.7425
	88.00	134.47600*	32.08062	.018	7.9195	261.0325
	91.00	135.71600*	33.35953	.030	4.1270	267.3050
	93.00	265.16800*	32.93834	.000	135.2381	395.0979
	94.00	174.48400*	31.86603	.000	48.7703	300.1977
	104.00	222.12400*	33.58431	.000	89.6480	354.5990
	113.00	78.08000	33.14233	1.000	-52.6533	208.8133
	114.00	-11.87600	34.03227	1.000	-146.1179	122.3659
	118.00	45.26400	28.47635	1.000	-67.2192	157.7472
	120.00	78.17200	32.64608	1.000	-51.3947	207.7387
	123.00	200.16200*	33.34151	.000	68.6341	331.6899
	124.00	57.25600	32.26587	1.000	-70.0285	184.5405
	125.00	299.01200*	32.05180	.000	172.5687	425.4553
	126.00	211.34800*	32.14124	.000	84.5533	338.1427

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
93.00	16.00	132.71600*	31.47117	.016	8.5754	256.8566
	20.00	-.10400	31.98584	1.000	-126.2735	126.0655
	22.00	-192.56800*	31.91314	.000	-319.4508	-66.6852
	25.00	-97.30400	34.14058	.923	-231.9891	37.3811
	26.00	-177.80800*	32.02213	.000	-304.1207	-51.4953
	28.00	-149.89600*	28.60591	.000	-263.5740	-36.2180
	32.00	37.53200	31.67741	1.000	-87.4213	162.4853
	36.00	-59.12800	32.73289	1.000	-188.2462	69.9902
	38.00	-51.54800	32.31487	1.000	-179.0157	75.9197
	48.00	77.31200	31.46809	1.000	-46.8165	201.4405
	52.00	-165.16800*	30.63072	.000	-286.7872	-43.5488
	54.00	-152.26000*	32.43077	.002	-280.1852	-24.3348
	57.00	-80.50400	32.46679	1.000	-208.5714	47.5634
	58.00	-199.17600*	32.70980	.000	-328.2031	-70.1489
	60.00	-180.96400*	27.32785	.000	-288.8833	-73.0447
	64.00	-29.32000	29.66434	1.000	-146.3684	87.7184
	72.00	-7.49600	32.79201	1.000	-136.8478	121.8558
	81.00	-75.40400	32.29509	1.000	-202.7936	51.9856
	82.00	-272.27600*	32.49175	.000	-400.4420	-144.1100
	86.00	-253.48000*	29.16639	.000	-368.5288	-138.4312
	88.00	-130.69200*	31.13381	.019	-253.5032	-7.8808
	91.00	-129.45200*	32.44987	.042	-257.4526	-1.4514
	92.00	-265.16800*	32.93834	.000	-395.0979	-135.2381
	94.00	-90.68400	30.91245	.861	-212.6249	31.2569
	104.00	-43.04400	32.68080	1.000	-171.9569	85.8689
	113.00	-187.08800*	32.22654	.000	-314.2071	-59.9689
	114.00	-277.04400*	33.14107	.000	-407.7752	-146.3128
	118.00	-219.90400*	27.40507	.000	-328.1231	-111.6849
	120.00	-186.99600*	31.92179	.000	-312.9129	-61.0791
	123.00	-65.01600	32.43133	1.000	-192.9434	62.9114
	124.00	-207.91200*	31.32446	.000	-331.4747	-84.3493
	125.00	33.84400	31.10391	1.000	-88.8503	156.5383
	126.00	-53.82000	31.19607	1.000	-176.8771	69.2371

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
94.00	16.00	223.40000*	30.34787	.000	103.6933	343.1067
	20.00	90.58000	30.68048	.861	-31.2344	212.3944
	22.00	-101.88400	30.60617	.433	-223.4007	19.6327
	26.00	-6.62000	33.10723	1.000	-137.2524	124.0124
	26.00	-87.12400	30.91807	.941	-209.0870	34.8380
	28.00	-59.21200	27.57337	1.000	-169.0009	49.5769
	32.00	128.21600*	30.56089	.019	7.6647	248.7673
	36.00	31.55600	31.65362	1.000	-93.3169	156.4289
	38.00	39.13600	31.22116	1.000	-84.0256	162.2976
	48.00	167.99600*	30.34387	.000	48.3019	287.6901
	52.00	-74.48400	29.68237	.993	-191.5674	42.5994
	54.00	-61.57600	31.34110	1.000	-185.2121	62.0601
	57.00	10.18000	31.37838	1.000	-113.6035	133.9635
	58.00	-108.49200	31.62975	.307	-233.2703	16.2863
	60.00	-90.28000	26.02540	.275	-193.0187	12.4587
	64.00	61.36400	28.46898	1.000	-50.9411	173.6691
	72.00	83.18800	31.71476	.984	-41.9268	208.3028
	81.00	15.28000	31.20088	1.000	-107.8008	138.3608
	82.00	-181.59200*	31.40420	.000	-305.4777	-57.7063
	86.00	-162.79600*	27.93931	.000	-273.0204	-52.5716
	88.00	-40.00800	29.99686	1.000	-159.3321	79.3161
	91.00	-38.76800	31.36086	1.000	-162.4822	84.9462
	92.00	-174.48400*	31.86603	.000	-300.1977	-48.7703
	93.00	90.68400	30.91245	.861	-31.2569	212.6248
	104.00	47.64000	31.59986	1.000	-77.0200	172.3000
	113.00	-96.40400	31.12972	.687	-219.2039	26.3959
	114.00	-186.36000*	32.07565	.000	-312.9034	-59.8166
	118.00	-129.22000*	26.10647	.001	-232.2745	-26.1655
	120.00	-96.31200	30.81413	.652	-217.8641	25.2401
	123.00	25.66800	31.34169	1.000	-97.9704	149.3064
	124.00	-117.22800	30.19490	.064	-236.3339	1.8778
	125.00	124.52800*	29.96604	.021	6.3255	242.7305
	126.00	36.86400	30.06169	1.000	-81.7160	155.4440

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
104.00	16.00	175.76000*	32.14684	.000	48.9503	302.5697
	20.00	42.94000	32.65086	1.000	-85.8539	171.7338
	22.00	-149.52400*	32.57945	.003	-278.0373	-21.0107
	26.00	-54.26000	34.76422	1.000	-191.3963	82.8763
	26.00	-134.76400*	32.68622	.024	-263.6979	-5.8301
	28.00	-106.85200	29.54239	.169	-223.4649	9.7609
	32.00	80.57600	32.34857	.989	-47.0283	208.1803
	36.00	-16.08400	33.38283	1.000	-147.7640	115.5960
	38.00	-8.50400	32.97308	1.000	-138.5681	121.5601
	48.00	120.35600	32.14362	.107	-6.4419	247.1539
	52.00	-122.12400	31.51992	.066	-246.4700	2.2220
	54.00	-109.21600	33.08665	.440	-239.7279	21.2959
	57.00	-37.46000	33.12186	1.000	-168.1112	93.1912
	58.00	-156.13200*	33.36020	.002	-287.7227	-24.5413
	60.00	-137.92000*	28.10308	.001	-248.9251	-26.9149
	64.00	13.72400	30.38000	1.000	-106.1522	133.6002
	72.00	35.54800	33.44081	1.000	-96.3607	167.4567
	81.00	-32.36000	32.95367	1.000	-162.3477	97.6277
	82.00	-229.23200*	33.14642	.000	-359.9796	-98.4844
	86.00	-210.43600*	29.68422	.000	-329.3734	-92.4986
	88.00	-87.64800	31.61624	.969	-213.1584	37.8624
	91.00	-86.40800	33.10537	.995	-216.9937	44.1777
	92.00	-222.12400*	33.58431	.000	-354.5990	-89.6490
	93.00	43.04400	32.68080	1.000	-85.8689	171.9569
	94.00	-47.64000	31.59986	1.000	-172.3000	77.0200
	113.00	-144.04400*	32.68649	.008	-273.7670	-14.3210
	114.00	-234.00000*	33.78317	.000	-367.2599	-100.7401
	118.00	-176.86000*	28.17817	.000	-288.1561	-65.5639
	120.00	-143.95200*	32.58792	.007	-272.4987	-15.4053
	123.00	-21.97200	33.08721	1.000	-152.4861	108.5421
	124.00	-164.66800*	32.00303	.000	-291.1128	-38.6232
	125.00	76.68800	31.78719	1.000	-48.6081	202.2841
	126.00	-10.77600	31.67737	1.000	-136.5267	114.9747

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
113.00	16.00	319.60400*	31.68461	.000	194.8203	444.7877
	20.00	186.98400*	32.19587	.000	59.9858	313.9822
	22.00	-5.48000	32.12265	1.000	-132.1935	121.2335
	25.00	89.78400	34.33743	.994	-45.6744	225.2424
	26.00	9.28000	32.23193	1.000	-117.8604	136.4204
	28.00	37.19200	29.03895	1.000	-77.4112	151.7952
	32.00	224.62000*	31.68947	.000	98.8294	350.4106
	36.00	127.96000	32.93815	.083	-1.9689	257.8889
	38.00	135.54000*	32.52279	.020	7.2525	263.8275
	48.00	264.40000*	31.68155	.000	139.4284	389.3716
	52.00	21.92000	31.04857	1.000	-100.5609	144.4009
	54.00	34.82800	32.63784	1.000	-93.9139	163.5699
	57.00	106.58400	32.67373	.485	-22.2991	235.4671
	58.00	-12.08800	32.91521	1.000	-141.9243	117.7483
	60.00	6.12400	27.57339	1.000	-102.7725	115.0205
	64.00	157.76800*	29.69069	.000	39.8323	275.7037
	72.00	179.59200*	32.99691	.000	49.4331	309.7509
	81.00	111.68400	32.50312	.302	-16.5259	239.8939
	82.00	-85.18800	32.69853	.995	-214.1690	43.7930
	86.00	-66.39200	29.38665	1.000	-182.3544	49.5704
	88.00	56.39600	31.34935	1.000	-67.2679	180.0599
	91.00	57.63600	32.65691	1.000	-71.1808	186.4528
	92.00	-78.08000	33.14233	1.000	-208.8133	52.6533
	93.00	187.08800*	32.22654	.000	59.9689	314.2071
	94.00	96.40400	31.12972	.687	-26.3959	219.2039
	104.00	144.04400*	32.88649	.008	14.3210	273.7670
	114.00	-89.95600	33.34383	.983	-221.4853	41.5733
	118.00	-32.81600	27.64991	1.000	-142.0095	76.3775
	120.00	.09200	32.13223	1.000	-126.6553	126.8393
	123.00	122.07200	32.62850	.109	-6.6721	250.8161
	124.00	-20.82400	31.53890	1.000	-145.2339	103.5859
	125.00	220.93200*	31.31986	.000	97.3841	344.4799
	126.00	133.26800*	31.41138	.015	9.3600	257.1760

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
114.00	16.00	409.76000*	32.61435	.000	281.1004	538.4196
	20.00	276.94000*	33.11126	.000	146.3262	407.5538
	22.00	84.47600	33.04103	.989	-45.8615	214.8135
	25.00	179.74000*	35.19716	.000	40.8999	318.5801
	26.00	99.23600	33.14632	.803	-31.5158	229.9878
	28.00	127.14800*	30.05085	.016	8.5255	245.7705
	32.00	314.57600*	32.61340	.000	185.1339	444.0181
	36.00	217.91600*	33.63348	.000	84.4579	351.3741
	38.00	225.49600*	33.42921	.000	93.6305	357.3615
	48.00	354.35600*	32.61139	.000	225.7081	483.0039
	52.00	111.87600	31.99879	.251	-14.3584	238.1104
	54.00	124.78400	33.54126	.117	-7.5228	257.0909
	57.00	196.54000*	33.57609	.000	64.0960	328.9840
	58.00	77.86800	33.61113	1.000	-55.5021	211.2381
	60.00	96.08000	28.63691	.385	-17.0507	209.2107
	64.00	247.72400*	30.67449	.000	125.8856	369.5624
	72.00	269.54800*	33.59086	.000	135.8644	403.2316
	81.00	201.64000*	33.41009	.000	69.8498	333.4302
	82.00	4.76800	33.60022	1.000	-127.7711	137.3071
	86.00	23.56400	30.38678	1.000	-96.3693	143.4973
	88.00	146.35200*	32.28874	.004	18.9716	273.7324
	91.00	147.59200*	33.56972	.007	15.2125	279.9715
	92.00	11.87600	34.03227	1.000	-122.3659	146.1179
	93.00	277.04400*	33.14107	.000	146.3129	407.7752
	94.00	186.36000*	32.07555	.000	59.8166	312.9034
	104.00	234.00000*	33.78317	.000	100.7401	367.2599
	113.00	89.95600	33.34383	.983	-41.5733	221.4853
	118.00	57.14000	28.71061	1.000	-56.2760	170.5560
	120.00	90.04800	33.04938	.977	-40.3224	220.4184
	123.00	212.02800*	33.54180	.000	79.7181	344.3389
	124.00	69.13200	32.47281	1.000	-58.9714	197.2354
	125.00	310.68800*	32.26011	.000	193.6200	438.1560
	126.00	223.22400*	32.34887	.000	95.6071	350.8409

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
118.00	16.00	352.62000*	26.76570	.000	246.9444	458.2956
	20.00	219.80000*	27.36900	.000	111.7244	327.8756
	22.00	27.33600	27.28400	1.000	-80.4014	135.0734
	25.00	122.60000*	29.85879	.027	4.6107	240.5893
	26.00	42.09600	27.41140	1.000	-66.1483	150.3403
	28.00	70.00800	23.57432	.828	-22.9973	163.0133
	32.00	257.43600*	27.00789	.000	150.7970	364.0750
	36.00	160.77600*	28.23844	.000	49.2399	272.3121
	38.00	168.35600*	27.75282	.000	58.7530	277.9590
	48.00	297.21600*	26.76209	.000	191.5548	402.8772
	52.00	54.73600	26.00984	1.000	-47.9337	157.4057
	54.00	67.64400	27.58769	1.000	-42.4958	177.7838
	57.00	139.40000*	27.92957	.000	29.0935	249.7065
	58.00	20.72800	28.21169	1.000	-90.7015	132.1575
	60.00	38.94000	21.74350	1.000	-46.8282	124.7082
	64.00	190.58400*	24.61687	.000	93.4494	287.7186
	72.00	212.40800*	28.30886	.000	100.5992	324.2168
	81.00	144.50000*	27.72978	.000	34.9887	254.0113
	82.00	-52.37200	27.95857	1.000	-162.7939	58.0499
	86.00	-33.57600	24.00131	1.000	-128.2733	61.1213
	88.00	89.21200	26.38797	.354	-14.8821	193.3061
	91.00	90.45200	27.90989	.514	-19.7762	200.6802
	92.00	-45.26400	28.47635	1.000	-157.7472	67.2192
	93.00	219.90400*	27.40507	.000	111.6849	328.1231
	94.00	129.22000*	26.10647	.001	26.1655	232.2745
	104.00	176.86000*	28.17817	.000	65.5639	288.1561
	113.00	32.81600	27.64991	1.000	-76.3775	142.0095
	114.00	-57.14000	28.71061	1.000	-170.5560	56.2760
	120.00	32.90800	27.29411	1.000	-74.8698	140.6856
	123.00	154.88800*	27.88834	.000	44.7456	265.0304
	124.00	11.99200	26.59305	1.000	-92.9970	116.9810
	125.00	253.74800*	26.33290	.000	149.7934	357.7026
	126.00	166.08400*	26.44169	.000	61.6969	270.4712

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
120.00	16.00	319.71200*	31.37460	.000	195.9527	443.4713
	20.00	186.89200*	31.89083	.000	61.0973	312.6867
	22.00	-5.57200	31.81791	1.000	-131.0791	119.9351
	25.00	89.69200	34.05159	.993	-44.6436	224.0276
	26.00	9.18800	31.92723	1.000	-116.7603	135.1263
	28.00	37.10000	28.70037	1.000	-76.1591	150.3591
	32.00	224.52800*	31.58147	.000	99.9533	349.1027
	36.00	127.86800	32.64004	.056	-.8846	256.6206
	38.00	135.44800*	32.22083	.017	8.3510	262.5450
	48.00	264.30800*	31.37151	.000	140.5609	388.0551
	52.00	21.82800	30.73214	1.000	-99.4015	143.0575
	54.00	34.73600	32.33706	1.000	-92.8199	162.2919
	57.00	106.49200	32.37319	.453	-21.2066	234.1906
	58.00	-12.18000	32.81690	1.000	-140.8412	116.4812
	60.00	6.03200	27.21659	1.000	-101.4445	113.5085
	64.00	157.67600*	29.56186	.000	41.0437	274.3083
	72.00	179.50000*	32.69934	.000	50.5131	308.4869
	81.00	111.59200	32.20099	.276	-15.4267	238.6107
	82.00	-85.28000	32.39822	.993	-213.0774	42.5174
	86.00	-66.48400	29.05212	1.000	-181.1191	48.1611
	88.00	56.30400	31.03589	1.000	-66.1214	178.7294
	91.00	57.54400	32.36621	1.000	-70.0876	185.1756
	92.00	-78.17200	32.84609	1.000	-207.7387	51.3947
	93.00	186.99600*	31.92179	.000	61.0791	312.9129
	94.00	96.31200	30.81413	.652	-25.2401	217.8641
	104.00	143.95200*	32.58792	.007	15.4053	272.4987
	113.00	-.09200	32.13223	1.000	-126.8393	126.6553
	114.00	-90.04800	33.04935	.977	-220.4184	40.3224
	118.00	-32.90800	27.29411	1.000	-140.6856	74.8696
	123.00	121.98000	32.33783	.087	-5.5782	249.5382
	124.00	-20.91600	31.22744	1.000	-144.0955	102.2635
	125.00	220.84000*	31.00620	.000	98.5318	343.1482
	126.00	133.17600*	31.09865	.012	10.5039	255.8482

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
123.00	16.00	197.73200*	31.69289	.000	71.9254	323.5386
	20.00	64.91200	32.40086	1.000	-62.8954	192.7194
	22.00	-127.55200*	32.32609	.050	-255.0765	-.0275
	25.00	-32.28800	34.52971	1.000	-169.5021	103.9261
	26.00	-112.79200	32.43669	.266	-240.7406	15.1566
	28.00	-84.68000	29.26606	.889	-200.3851	30.6251
	32.00	102.54800	32.09642	.586	-24.0600	229.1560
	36.00	5.68800	33.13855	1.000	-124.8286	136.6049
	38.00	13.46800	32.72572	1.000	-115.6200	142.5560
	48.00	142.32800*	31.68985	.006	16.5333	269.1227
	52.00	-100.15200	31.26109	.556	-223.4736	23.1696
	54.00	-87.24400	32.64017	.980	-216.7834	42.2954
	57.00	-15.48800	32.67574	1.000	-145.1678	114.1918
	58.00	-134.16000*	33.11575	.033	-264.7868	-3.5332
	60.00	-115.94800*	27.61247	.021	-225.7961	-6.0999
	64.00	35.69600	30.11137	1.000	-83.1147	154.5067
	72.00	57.52000	33.19685	1.000	-73.4273	188.4673
	81.00	-10.38800	32.70619	1.000	-139.3990	118.6230
	82.00	-207.26000*	32.90039	.000	-337.0370	-77.4830
	86.00	-188.46400*	29.61109	.000	-305.3171	-71.6109
	88.00	-65.67600	31.56984	1.000	-190.1722	59.8202
	91.00	-64.43600	32.85903	1.000	-194.0498	65.1778
	92.00	-200.15200*	33.34151	.000	-331.6699	-68.6341
	93.00	65.01600	32.43133	1.000	-62.9114	192.9434
	94.00	-25.66800	31.34169	1.000	-149.3064	97.9704
	104.00	21.97200	33.08721	1.000	-109.5421	152.4861
	113.00	-122.07200	32.63850	.109	-250.8161	6.6721
	114.00	-212.02800*	33.54180	.000	-344.3369	-79.7191
	118.00	-154.88800*	27.88834	.000	-265.0304	-44.7456
	120.00	-121.98000	32.33763	.097	-249.5382	5.5782
	124.00	-142.89600*	31.74813	.005	-268.1329	-17.6591
	125.00	98.86000	31.53065	.640	-25.6209	223.2409
	126.00	11.19600	31.62146	1.000	-113.5425	135.9345

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
124.00	16.00	340.62800*	30.76665	.000	219.2675	461.9885
	20.00	207.80800*	31.29291	.000	84.3699	331.2461
	22.00	15.34400	31.21860	1.000	-107.8006	138.4886
	25.00	110.60800	33.49226	.439	-21.5330	242.7490
	26.00	30.10400	31.33001	1.000	-93.4806	153.6886
	28.00	58.01600	28.03449	1.000	-52.6011	168.6331
	32.00	245.44400*	30.97759	.000	123.2611	367.6369
	36.00	148.78400*	32.05611	.002	22.3293	275.2387
	38.00	156.38400*	31.62915	.001	31.5974	281.1306
	48.00	285.22400*	30.76350	.000	163.8760	406.5720
	52.00	42.74400	30.11122	1.000	-76.0321	161.5201
	54.00	55.65200	31.74755	1.000	-89.5826	190.8866
	57.00	127.40800*	31.78435	.039	2.0279	252.7881
	58.00	8.73600	32.03254	1.000	-117.6255	135.0975
	60.00	26.94800	26.51347	1.000	-77.7314	131.6274
	64.00	178.59200*	28.91583	.000	64.5185	292.6655
	72.00	200.41600*	32.11648	.000	73.7225	327.1095
	81.00	132.50800*	31.60894	.018	7.8213	257.1947
	82.00	-64.36400	31.60984	1.000	-189.8449	61.1169
	86.00	-45.56800	28.39449	1.000	-157.5957	66.4597
	88.00	77.22000	30.42128	.668	-42.7782	197.2182
	91.00	78.46000	31.76706	1.000	-46.8517	203.7717
	92.00	-57.26600	32.26587	1.000	-184.5405	70.0285
	93.00	207.91200*	31.32446	.000	84.3493	331.4747
	94.00	117.22800	30.19490	.064	-1.8778	236.3339
	104.00	164.66800*	32.00303	.000	38.6232	291.1128
	113.00	20.82400	31.53280	1.000	-103.5859	145.2339
	114.00	-69.13200	32.47281	1.000	-197.2354	58.9714
	118.00	-11.99200	26.59305	1.000	-116.9810	92.9970
	120.00	20.91600	31.22744	1.000	-102.2635	144.0955
	123.00	142.89600*	31.74813	.005	17.6591	268.1329
	125.00	241.75600*	30.39088	.000	121.8777	361.6343
	126.00	154.09200*	30.48620	.000	33.8418	274.3422

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
125.00	16.00	98.87200	30.54208	.515	-21.6031	219.3471
	20.00	-33.94800	31.07214	1.000	-156.5167	88.6207
	22.00	-226.41200*	30.99730	.000	-348.6850	-104.1390
	25.00	-131.14800	33.28609	.051	-262.4809	.1849
	26.00	-211.65200*	31.10950	.000	-334.3684	-88.9356
	28.00	-183.74000*	27.78785	.000	-293.3790	-74.1010
	32.00	3.68800	30.75455	1.000	-117.6261	125.0021
	36.00	-92.97200	31.64083	.872	-218.5796	32.6356
	38.00	-85.39200	31.41074	.978	-209.2992	38.5152
	48.00	43.46800	30.53890	1.000	-76.9946	163.9306
	52.00	-199.01200*	29.68172	.000	-316.8821	-81.1419
	54.00	-186.10400*	31.52996	.000	-310.4826	-61.7254
	57.00	-114.34800	31.56702	.165	-239.8732	10.1772
	58.00	-233.02000*	31.61690	.000	-359.5337	-107.5063
	60.00	-214.80800*	26.25253	.000	-318.4497	-111.1663
	64.00	-63.16400	28.67676	1.000	-176.2912	49.9632
	72.00	-41.34000	31.90141	1.000	-167.1881	84.5081
	81.00	-109.24800	31.36039	.264	-233.0747	14.5787
	82.00	-306.12000*	31.59268	.000	-430.7467	-181.4933
	86.00	-287.32400*	29.15100	.000	-398.3869	-176.2611
	88.00	-164.53600*	30.19413	.000	-283.6380	-45.4340
	91.00	-163.29600*	31.54981	.000	-287.7523	-38.8397
	92.00	-299.01200*	32.05180	.000	-425.4553	-172.5687
	93.00	-33.84400	31.10391	1.000	-156.5383	88.8503
	94.00	-124.52800*	29.96804	.021	-242.7305	-6.3255
	104.00	-76.88800	31.78719	1.000	-202.2841	48.5081
	113.00	-220.93200*	31.31986	.000	-344.4799	-97.3841
	114.00	-310.88800*	32.26011	.000	-438.1560	-183.6200
	118.00	-253.74800*	26.33290	.000	-357.7026	-149.7934
	120.00	-220.84000*	31.00620	.000	-343.1482	-98.5318
	123.00	-98.86000	31.53055	.840	-223.2409	25.5209
	124.00	-241.75600*	30.39089	.000	-361.6343	-121.8777

Tamhane

(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
125.00	126.00	-87.66400	30.25853	.880	-207.0201	31.6921
126.00	16.00	186.53600*	30.63593	.000	65.6910	307.3810
	20.00	53.71600	31.16439	1.000	-69.2159	176.6479
	22.00	-138.74800*	31.08977	.006	-261.3851	-16.1109
	25.00	-43.48400	33.37221	1.000	-175.1545	88.1865
	26.00	-123.98800*	31.20164	.045	-247.0671	-.9089
	28.00	-96.07600	27.89098	.285	-206.1239	13.9719
	32.00	91.35200	30.84775	.835	-30.3283	213.0333
	36.00	-5.30800	31.93066	1.000	-131.2695	120.6535
	38.00	2.27200	31.50201	1.000	-121.9942	126.5382
	48.00	131.13200*	30.63276	.012	10.2985	251.9645
	52.00	-111.34800	29.97764	.119	-229.5987	6.9007
	54.00	-98.44000	31.62088	.687	-223.1762	26.2962
	57.00	-26.68400	31.65782	1.000	-151.6663	98.1983
	58.00	-145.35600*	31.90700	.004	-271.2239	-19.4881
	60.00	-127.14400*	26.36166	.001	-231.2196	-23.0684
	64.00	24.50000	28.77689	1.000	-89.0227	138.0227
	72.00	46.32400	31.99127	1.000	-79.8773	172.5253
	81.00	-21.58400	31.48171	1.000	-145.7700	102.6020
	82.00	-218.45600*	31.68342	.000	-343.4395	-93.4725
	86.00	-199.66000*	29.25279	.000	-311.1262	-88.1938
	88.00	-76.87200	30.28906	.998	-196.3485	42.6045
	91.00	-75.63200	31.64047	1.000	-200.4457	49.1817
	92.00	-211.34800*	32.14124	.000	-338.1427	-84.5533
	93.00	53.82000	31.19607	1.000	-69.2371	176.8771
	94.00	-36.86400	30.06169	1.000	-155.4440	81.7160
	104.00	10.77600	31.87737	1.000	-114.9747	136.5267
	113.00	-133.26800*	31.41139	.015	-257.1760	-9.3600
	114.00	-223.22400*	32.34897	.000	-350.8409	-95.6071
	118.00	-166.08400*	26.44169	.000	-270.4712	-61.6968
	120.00	-133.17600*	31.09865	.012	-255.8482	-10.5038
	123.00	-11.19600	31.62148	1.000	-135.9345	113.5425
	124.00	-154.09200*	30.48520	.000	-274.3422	-33.8418
	125.00	87.66400	30.25853	.880	-31.6921	207.0201

M. VARIATION OF WINDOW OF OPPORTUNITY FOR CONDITION 15

Condition	Time	Condition	Time	Condition	Time	Condition	Time
5	1619	45	918	85	1311	125	1120
6	1673	46	1283	86	1278	126	1279
7	1443	47	1158	87	1196	127	1043
8	1329	48	1382	88	1304	128	1586
9	1527	49	1445	89	1377	129	1124
10	1384	50	1312	90	1269	130	1344
11	1916	51	1169	91	1190	131	1504
12	1332	52	1334	92	1318	132	1164
13	1265	53	1378	93	1219	133	1228
14	1356	54	1124	94	1238	134	1263
15	1511	55	1280	95	1118	135	1456
16	1364	56	1258	96	1259	136	1499
17	1320	57	1445	97	1323	137	1352
18	1590	58	1288	98	1175	138	1403
19	1006	59	1185	99	1345	139	1203
20	1413	60	1372	100	1116	140	1142
21	1131	61	1367	101	1099	141	1240
22	1324	62	1315	102	1375	142	1160
23	1355	63	1349	103	1324	143	1141
24	1272	64	1113	104	1152	144	1278
25	1275	65	1137	105	1225	145	1342
26	1182	66	1337	106	1446	146	958.7
27	1216	67	1300	107	1200	147	1295
28	1520	68	1227	108	1105	148	1424
29	1190	69	1248	109	1538	149	1259
30	1339	70	1336	110	1213	150	1384
31	1261	71	1365	111	1329	151	1282
32	1281	72	1286	112	1186	152	1348
33	1281	73	1379	113	1287	153	1234
34	1255	74	1397	114	1177	154	1428
35	1310	75	1404	115	1239	155	1408
36	1327	76	1622	116	1230	156	1443
37	1721	77	1400	117	1365	157	1024
38	1264	78	1310	118	1237	158	1372
39	1122	79	1495	119	1436	159	1393
40	1373	80	1339	120	1148	160	1296
41	1294	81	1390	121	1352		
42	1120	82	1449	122	1407		
43	1236	83	1193	123	1536		
44	1430	84	1328	124	1245		

VITA

Jose J. Padilla

Engineering Management and Systems Engineering Department

Jose J. Padilla received his Master of Business Administration degree from Lynn University, Boca Raton, Fl. in 2003 and his Bachelor's degree in Industrial Engineering from La Universidad Nacional de Colombia, Medellin, Colombia in 1997. He has served as a graduate research assistant for the Engineering Management and Systems Engineering (EMSE) Department at Old Dominion University, Norfolk, VA. Jose J. Padilla has been a member of the research team in The National Centers for System of Systems Engineering (NCSOSE) within the EMSE Department. His research interests are focused on understanding, philosophy of science, and the use of M&S for theory building.