MATH TEACHERS' INTUITIONS ABOUT STUDENT SUCCESS IN ALGEBRA

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CHAPTER I

INTRODUCTION

Today, the need for teachers to be good decision-makers and reflective practitioners is more important than ever (Giovannelli, 2003). The ability to reflect and make decisions is a process that is vital if educators are going to be successful (Giovannelli). How individuals monitor the ebb and flow of classroom instruction, identify what cues exist, and then make a decision as to which direction to take is the stock-and-trade of a teacher's typical day. If teachers possess the requisite skills to teach, then fundamentally the act of teaching is really a decision-making process in which one selects a particular skill, response, or method over another. This decision process is an attempt to select, from one's pedagogical repertoire, a solution that they feel will be equal to the situation. The choice selected by the individual does not guarantee success, but it meets what Simon and Kadane (1975) referred to as "satisficing" (p.235).

Teacher education has historically had the goal of preparing reflective decision-makers (Cruickshank, 1991; Kelsay, 1989). The National Council for the Accreditation of Teacher Education (NCATE), a nationally recognized sanctioning and accrediting body for teacher preparation programs placed special emphasis on the reflective, decision-making skills of teachers. NCATE literature addressed this specific issue in their

accreditation standards (2003). Within their standards they stated teachers must be able to monitor vast amounts of incoming information and then make decisions in order to maximize student learning.

This process of thinking is fundamental to the decisions teachers make. Teacher effort is expended in form of identifying classroom needs. They then attempt to match such needs with personal and professional assets equal to the task. This act of reflecting and making a decision or problem-solution matching is deemed necessary in order to bring about or maintain success in the classroom. However, the teacher's context significantly affects their decision processes (Colton & Sparks-Langer, 1993).

Naturalistic environments such as the classroom, unlike laboratories, are high-speed, multi-layered and dynamic. In contrast, laboratories, which conduct studies on decision-making, typically control for all other extraneous factors in order to focus on the phenomenon in question. Not only is the classroom a dynamic environment, but teachers are equally dynamic phenomena in their own right as they juggled several internal, external, personal and professional variables simultaneously while making decisions. Although there may have been many ways for a decision to be made, this dissertation attempts to examine the complex mechanisms behind teachers' intuitively-derived decision-making processes made in naturalistic, ill-structured environments.

Background to the Problem

According to Burke and Sadler-Smith (2006), the complexities of decision-making mechanisms are equally matched by the complexities of the classroom environment in which teachers make decisions. The amalgam of characteristics used to

describe such complicated decision contexts was recently labeled by researchers as "naturalistic decision-making" or NDM (Montgomery, Lipshitz & Brehmer, 2005, p. 1).

The actual classroom, situated within its multi-faceted context, was a good match for what Orasanu and Connolly (1993) described as a naturalistic decision-making environment. They defined such naturalistic settings as those that possess the following eight characteristics: 1) ill-structured problems 2) uncertain dynamic environments 3) shifting, ill-defined or competing goals 4) action/feedback loops 5) time stress 6) high stakes 7) multiple players and 8) organizational goals. Based on these dynamics, teachers needed to find a way to monitor and process these inherent characteristics

Successfully performing the act of teaching is fundamentally the act of making decisions (Behre, Astor & Meyer, 2001; Ferry & Ross-Gordon, 1998). Teaching however, contains complex dynamics among multiple processes in order to make a decision. For teachers, some of the dynamics range from personal beliefs of what worked to utilizing techniques considered best practice within the profession. Additionally, other processes span from the use of emotion to guide decisions to claims of pure cognition only, and from the formulaic, data-driven to the purely intuitive. To be sure, this is a partial list, but gives one the sense of what must be successfully managed if one desired any degree of success as a teacher (Humphreys & Hyland, 2002).

What is consistent though is teachers' needed to manage confusing and often overlapping variables in order to make decisions. In particular, mathematics education appears to have placed additional emphasis on the role of classroom variables as predictors of individual student success. According to Penner, Batsche, Knoff and Nelson (1993), the crisis in mathematics education could be traced back the 1989 National

Education Summit held in Virginia (1997). This meeting was attended by then President George Bush and the governors of all 50 states. That summit placed renewed concern for understanding what made American children successful in mathematics. Based on the results of that meeting and a review of mathematics education literature, key variables were selected to be used in this study to identify student characteristics relevant to learning math. This study then focused on how Algebra I teachers observed and managed these variables in order to make decisions about student performance.

Gender

Understanding gender differences and performance in math has long been the focus of many studies (Schreiber & Chambers, 2003). Although struggling with math appeared to be equally common in males and females (Dowker, 2005), it has been considered a cultural norm in American society to assume males are better in math. According to Schreiber and Chambers, this perception was only partially true, but they were clear that what little gap may exist between males and females has been getting smaller. Dowker believed the present debate regarding differences appeared to focus on both biological (Geary, 1996) as well as environmental factors such as the types of toys and freedoms boys are given to explore. Another example seems to focus on spatial-perceptual differences between girls and boys (Dowker). However, according to Dowker, algebraic abilities do not necessarily have a spatial component. Dowker stated that some attempted to explain differences with a phenomenon referred to as “single-minded concentration” (2005, p. 8). This phenomenon was defined as the ability to focus on a single task for an extended amount of time. It seemed that a females’ ability to multi-task

may have done more harm than good not permitting the individual to have sustained focus on a particular math problem.

Ethnicity

According to Byrnes and Miller (2007), the equitable treatment of diverse students encourages those same students to take advantage of existing academic opportunities. Children often detected unstated cultural assumptions within the behaviors of the teacher or school climate. Penner et al. (1993) emphasized the implications of culture and racial assumptions among the educational establishment. These implications not only affected the teacher, but the child as well. They contended that one's race and culture imbued within the mind of the child certain presuppositions regarding a lack of power and ability as well as lowered or negative expectations. Penner et al. stressed that failure to understand these "ecological adaptations" (p. 229) pervaded the academic context would forever doom educators to misunderstanding the potential of these students.

Previous Performance

Prior performance, as indicated by GPA, for example appears to be a predictive index regarding future academic achievement and general ability (Byrnes & Miller, 2007). They articulated how prior performance reflected future ability. Ability, which consists of skills, domain-specific aptitudes and intelligence, may have contributed to a student's future desire to succeed and take advantage of learning opportunities (Byrnes & Miller). Schreiber and Chambers (2003) continued this line of thought when they

emphasized that learners were constantly constructing knowledge and that new knowledge depended upon both current and prior understandings.

Self-Concept

According to Schreiber and Chambers (2003), a positive self-concept in math is associated with higher levels of achievement. One issue from the literature in particular that surfaced was anxiety associated with math. Dowker (2005) stated that females typically reported more anxiety regarding math. It was unclear if this was the cause or the effect of biological or societal factors. It seemed clear from the literature, regardless of the student's gender, anxiety's effect on self-concept played an important role in achievement (Byrnes & Miller, 2007).

Socioeconomic Status

Socioeconomic status (SES) and its traditionally positive impact on achievement in all content areas have been studied at length as well (Schreiber & Chambers, 2003; Ma & Kishor, 1997). The idea was SES correlated positively with levels of achievement. Byrnes and Miller (2007) found that SES had significant impact on short-term as well long-term factors leading to success in math.

Therefore, based on the research, gender (Dowker, 2005; Geary, 1996), ethnicity (Penner et al., 1993), Grade Point Average (GPA) (Schreiber & Chambers, 2003), self-concept (Schreiber & Chambers, 2003), and socioeconomic status (Ma & Kishor, 1997) were utilized as cues identifying each student. Teachers were asked to utilize these contextual cues to make intuitive decisions in the form of predictions regarding students'

future performance on an upcoming standardized test. Next, statistical analyses were employed to not only understand how teachers' utilized the supplied cues, but also how accurate they actually were in their predictions. Ultimately, by understanding the dynamics of how teachers use extant cues and their eventual predictive accuracy, interventions could be potentially developed to better train teachers to quickly process such an array of classroom and student cues.

Making Decisions

In order for mathematics teachers to manage a complex set of variables, they need to have the ability to make decisions. A teacher's ability to make decisions in ill-defined and shifting contexts, such as the typical classroom, could not be accomplished by purely rational, algorithmic means (Humphreys & Hyland, 2002). What is needed is a tool for teachers to help make decisions when sifting through the multifarious layers constituting today's classrooms. One option proposed by many familiar with the various choices among decision-making systems is intuition (Burke & Sadler-Smith, 2006; Cloninger, 2006; Humphreys & Hyland, 2002). It seems that in ill-defined environments, such as nursing, business management and education, individuals tend to acknowledge the use of intuition (Miller, 1993; Rew, 2000). In fact Miller, who studied the intuitive practices of nurses, found they were willing to utilize treatments and strategies which were not necessarily considered traditional. Instead, nurses relied on their own perceptual processes as they interacted with patients. Similar to the ill-structured situations of nurses, some researchers believe intuition, as opposed to slower, more deliberate, formulaic methods, is better suited for the fluid nature of the classroom (Burke & Sadler-

Smith, 2006; Humphreys & Hyland, 2002; Johansson & Kroksmark, 2004; Klein, Orasanu, Calderwood & Zsambok, 1993).

Intuition

Based on the characteristics of difficult decision spaces typically found in classrooms; teachers need decision-making models which are less rigid and more dynamic. Decision-making methods, such as Bayesian-style models, required deep reflection and analysis; luxuries naturalistic decision-making (NDM) contexts do not typically provide (Kahneman & Tversky, 1982; Montgomery, Lipshitz & Brehmer, 2005). This study attempts to understand how flexible decision methods are used by teachers. The decision construct investigated in this study is intuition. Having identified the focus of the study, the construct of intuition needed to be briefly defined and operationalized.

A survey of the literature reveals that intuition appears to be the nexus of many characteristics. According to Cloninger (2006), intuition was implicit, tacit, nondiscursive, and may serve as a precursor in informing rational thinking. This idea ran contrary to the explicit and discursive presuppositions education has long seemed to adhere (Cloninger). While possibly playing a role in rational thinking, intuition appeared to be both a cause and an effect of creativity (Bastick, 1982; Rew, 2000)

Elsewhere, Masters and Masters (1989) found that often times a person's decisions were controlled by their emotions and thus their willingness to take intuitive risks. Cloninger (2006) seemed to agree with intuition containing emotional overtones and stated that it was closely associated with the feeling of certainty and conviction as

Buber (1958) believed. Another emotionally-related characteristic of intuition was its close association with reflection (Kosowski & Roberts, 2003; Rew, 2000). In particular Rew found interestingly enough that the catalyst for reflective dispositions was empathy. The empathic nature of intuition was linked to one's compassion and care for others (Buber, 1958; Noddings & Shore, 1984). Leners (1992) took the empathic, emotional aspects of intuition a step further and postulated that intuition actually takes on spiritual, transpersonal, and even possibly healing characteristics.

Additionally, the role of pattern finding or pattern utilization was found to be significant for intuitive individuals (Leners, 1992). Intuition was further described as the association of one's objective, past experiences and the subjective emotions involved in that experience (Bastick, 1982). This dyad was then intuitively brought or recalled forward based on cue similarities found in the current situation one was presently dealing with.

Some intuition researchers felt that deductive and abductive forms of thinking should not be set in opposition to each other. Rather, they were to be viewed as elements, co-existing in typical problems. Bastick's (1982) theory of intuition acknowledged this co-existence of thinking forms, but he referred to the role of experiences as necessary and the objective source of data with which one may refer. Hammond's (1955) work found that the use of intuition did not exclude one's use of tangible data or other traditional, analytic sources. Instead of being mutually exclusive dichotomies, he felt that both intuitive and analytical were involved, to varying degrees, in making decisions. Hammond felt they were merely opposite ends of a continuum. As a result, he believed every decision one made involved a little analysis and a little intuition. To this end,

Hammond helped develop the foundation of Social Judgment Theory, the theoretical framework used in this study.

Statement of the Problem

There appears to be a large amount of research that tends to view decision-making as algorithmic in nature (Anderson, 2005; Edwards 1968; Gluck & Bower, 1988). Such research described decision-making as a slow, careful, deeply reflective analysis of the situation combined with a survey of all potential options from which a plan of action was generated. While such rational decision-making strategies worked in well-defined situations, their limitations were more evident in ill-defined contexts similar to those presented in teaching (Burke & Sadler-Smith, 2002). Some theorists believed intuitive decision-making strategies were better suited for educational contexts, and may provide the teacher with a higher degree success (Burke & Sadler-Smith, 2002; Humphreys & Hyland, 2002; Johansson & Kroksmark, 2004; Orasanu & Connolly, 1993).

One ill-defined area in which teachers make numerous decisions is facilitating success in mathematics for all students (Byrnes & Miller, 2007; Munoz, 2000; Schreiber & Chambers, 2003). Teachers, within the milieu of the mathematics classroom, need to be able to monitor various aspects of student achievement and behavior in order to purposefully and intentionally facilitate academic success. Byrnes and Miller, however, stated that predicting success tends to be based on too few factors and, as a result, they felt teachers did not have an adequate sense of how various predictors worked together. In fact, the mathematics education literature cited several observable cues considered to be relevant predictors of student performance. In particular, the literature noted gender (Dowker, 2005; Geary, 1996), ethnicity (Penner, et al, 1993), Grade Point Average

(GPA) (Schreiber & Chambers, 2003), self-concept (Schreiber & Chambers, 2003), and socioeconomic status (Ma & Kishor, 1997). Not only did the literature cite several variables, but Penner et al. expressed concerns in making educational decisions when there were potentially strong interconnections among the array of variables. It was believed intuitive decision-making processes were better suited to such ill-defined, often unclear contexts like today's classroom (Burke & Sadler-Smith, 2006 Heald, 1991 Humphreys & Hyland, 2002). Additionally, evidence suggested making decisions using competing, interconnected variables is processed more accurately from an intuitive perspective (Cloninger, 2006).

Significance of the Study

Humphreys and Hyland (2002) criticized the tendency of those in education who, too often relied on decision processes that tend to be positivistic. In today's climate, Bayesian or empirically-derived decisions appeared to be the most popular (Humphreys & Hyland). They continued their criticism when they stated that the present popularity of rational, data-driven approaches seemed to ignore the complexities inherent in the classroom. As a result of such actions, educators may have oversimplified the solutions to today's academic decisions. Byrnes and Miller (2007) believe that efforts to understand students' math achievement, has typically erred because the researcher tended to break down the task into increasingly smaller, seemingly more easily analyzed pieces.

Not only is determining success in mathematics complex (Burke & Sadler-Smith, 2006), but the classroom itself is a complicated and dynamic environment further exacerbated by the human element of teachers, who themselves possess complicated

psychological systems (Heald, 1991). Humphreys and Hyland (2002) believed that the desire of those in education for systematized, simplified teacher-proof decision strategies may have actually de-skilled and de-professionalized the teaching profession. They further explained that this may have occurred by eroding teachers' autonomy and the importance of professional judgment. Instead, the construct of intuition was the means to capitalize on the match between the shifting dynamics of the classroom with the teacher's ability to use flexibility in applying their cognitive resources to make decisions.

For teachers, making good decisions in order to facilitate students' success in math does not occur in a simple, coherent, laboratory-like environment. Such environments often have well-defined parameters and controlled conditions. Instead teachers made decisions in situations that are elusive and naturalistic. According to Orasanu and Connolly (1993), one fundamental difference between the lab and the real world of the classroom is that decisions made in the classroom are often nested within larger decision contexts. The stripping away of competing, often overlapping stimuli, inherent in lab-like situations, eliminates the antecedents necessary to fully understand the phenomena under study. Realizing that teachers make decisions within a confluence of factors, embedded within the context of the classroom, further encourages the use of intuition as a potentially superior decision-making mechanism (Schreiber & Chambers, 2003). What is needed is a way to understand how math teachers use extant cues and easily accessible information in order to make those decisions. Developing an understanding of the intuitive decision-making constructs teachers use is important to understand given that classroom characteristics tended to minimize the teacher's ability to make decisions considered more rational and analytic (March, 1976). Social Judgment

Theory (SJT) appears to be a framework to better analyze and operationalize sophisticated decision-making systems such as intuition (Cooksey, 1996; Hammond, 1996; Heald, 1991).

Theoretical Framework

Social Judgment Theory (SJT) was derived from the foundation laid by Brunswik (1952) and is considered a subset of the larger body of Judgment Analysis research (Cooksey, 1996a). Brunswik's original work was in the area of visual perception. During the middle of the 20th century, he observed the efforts of many in psychology. He felt much of their effort was misplaced (Cooksey, 1996a). In his opinion, psychology was wrong-headed because it put supposedly average subjects in atypical conditions, pursuing objectives that were not naturally a part of the organism's environment and yet continued to call itself a science (Cooksey, 1996a). He felt instead that the main task of psychology was first to understand the relationship between organism and environment. Secondly, he felt this relationship was based on uncertain connections among the variables in that context. These two principles were essential to an approach he proposed called "probabilistic functionalism" (Cooksey, 1996a, p. 1). Later his work was further advanced by Hammond (1955) and others and has taken shape into what is now considered Social Judgment Theory or SJT (Cooksey, 1996a; Hammond, McClelland & Mumpower, 1980; Hammond, Stewart, Brehmer & Steinmann, 1975;). According to Cooksey, researchers who used SJT sought to understand how individuals made their decisions based on how those individuals observed available, proximal cues. For Brunswik, research into individuals' behaviors focused on the simultaneous interaction of

distal, proximal, and central cues as the organism interacted with their environment. The proximal cues became the lens through which the individual internalized or centralized the situation in order to make their intuitive decision regarding the distal criterion of interest. The idea of a lens formed the central, conceptual model within SJT and would become known as the "lens theory" (Heald, 1991, p. 347).

The lens model consisted of cues which, according to Heald (1991), were available elements or observations, found within a given context and were considered relevant by the teacher for the decision task. The lens model, which would at a later time be further developed mathematically into the Lens Model Equation (LME), was first developed by Hursch, Hammond and Hursch (1964). The selection of cues was referred to as "representative design" (Cooksey, 1996a, p. 4). As its name implies, this concept was meant to emphasize the importance of including all necessary cues embedded in the actual, real-world decision. These cues helped represent or re-create the subject's decision space. The degree of accuracy of the representative design lead to another tenet of SJT referred to as "ecological validity" (Cooksey, 1996a, p. 2).

Ecological validity was defined as the correlation between proximal cues and the distal criterion. Accuracy in ecological representation, according to Cooksey (1996a), was necessary for generalizability of one's results. Both representative design and ecological validity were used to guide researchers in accurately extracting specific cues from the original decision context or ecology. The selected cues possessed both meaning to the subject and accurately depicted essential elements of the construct under study. Cues that were meaningful and relevant to the subject lead to their increased utility. This

formed yet another tenet of SJT called “cue utilization validity” (Cooksey, 1996a, p. 142).

Cue utilization validity represented a correlation between the actual value of a proximal cue and the subject’s utilization or perceived value of the cue. Cues were used by subjects in an effort to reduce uncertainty in decision. The subject acted within their decision space by organizing cues in some order to determine which ones were related in some way to the distal criterion (Cooksey, 1996a; Hammond, 1996). The distal criterion was whatever the decision-making efforts were focused toward. The subject’s decision space was referred to as the “zone of ambiguity” (Cooksey, 1996a, p. 11) because causal and correlational linkages between cues and the criterion were unclear. The zone of ambiguity existed on both the subject’s side of the lens as well as the actual or ecological side in which the phenomena occurred. Both zones of ambiguity existed serially because of the often overlapping, inter-correlated nature of available cues (Cooksey). As a result of such uncertainty, variables or combinations of variables were many times substitutable. This vicarious attribute existed in both the actual ecology and in the judge’s cognitive system. Cooksey (1996b) called these “vicarious mediation” and “vicarious functioning,” respectively (p. 142).

The tangled, overlapping nature of cues in the decision context provided the impetus to recreate, within SJT research studies, a design that accurately reflected the original environment. Such concern was considered relevant, because in SJT research studies, the goal is to elicit internal processes similar to those when in a judgment scenario in the real world. A concern for accurate reproduction of internal processes reflected Brunswik’s (1952) original issue with psychological research being conducted

in laboratories. The judge's ability to accurately match internal representations of external phenomena is referred to as the "principle of parallel concepts" (Cooksey, 1996a, p. 142). This occurs when one's ecology and one's perceptual/cognitive systems conveyed information about the same construct. Statistical analyses utilized in SJT methodology are used to not only look at the actual intuitive judgment made, but also how the judges utilizes their decision policies from profile to profile (Cooksey, 1996a). This was important because, although the values of the cues between profiles would change, the types of cues remained the same. Additionally, SJT researchers typically use known data, previously determined about the phenomenon under study. Therefore researchers not only assess policy formation, and thus the consistency of cue utilization, but the accuracy of the decisions made among an entire set of profiles. As a result, cue selection has important theoretical and analytical implications for understanding the mechanics of the decision-making process.

When studying intuition, one is not only concerned with the process but with the ultimate product, the accuracy of one's decision (Hammond, 1996). The relationship between one's intuitive predictions and the actual, eventual outcome is known as "achievement" (Doherty & Kurz, 1996, p. 123). Achievement is a measure of correspondence between the subject's response and the actual results of an event. It measures judgmental accuracy because it allows the researcher to understand how the subject uses cues within the environment. Achievement is the degree of correlation between the judge's decision or prediction and the actual, known characteristics of the criteria. It is for this reason that SJT researchers typically use pre-existing data from actual cases (Cooksey, 1996a; Doherty & Kurz). This feature again honored Brunswik's

(1952) original intent of using real-world situations, while it allows the researcher to study the fullest and most natural expression possible of the phenomenon. Although the subject or judge understands the general nature of the situation, they cannot be absolutely certain of the linkages among the contextual factors. The subject's ability to organize their cognitive space and still maintain a high level of prediction accuracy in the face of contextual uncertainties is the essence of this methodology of intuitive research (Hammond; Cooksey).

Purpose of the Study

The current emphasis in education has been to rationally examine and reflect on the data, note what standards were met or not met, and then make an instructional decision (Cloninger, 2006). However, such rational decision-making processes are believed by some to be too reductionistic and not equal to the complexities actually found in the classroom and learning process (Burke & Sadler-Smith, 2002; Cloninger, 2006, Humphreys & Hyland, 2002).

The purpose of this research study was to utilize Social Judgment Theory (SJT) to determine the effectiveness of math teachers' judgments or predictions regarding a student's future achievement. Judgments were based on specific cues used as predictors of success. These decisions, made in the form of predictions, were also examined for possible evidence of intuition in their formation. For this study, the teachers made judgments on the students' future performance on the Algebra 1 end-of-instruction assessment used by the state of Oklahoma. The cues were determined by a critical review of the mathematics education literature and considered relevant predictors of student

performance. The cues used for the predictions in this study were gender (Dowker, 2005; Geary, 1996), ethnicity (Penner, Batsche, Knoff & Nelson, 1993), Grade Point Average (GPA) (Schreiber & Chambers, 2003), self-concept (Schreiber & Chambers), and socioeconomic status (Ma & Kishor, 1997).

Research Questions

A concern for student success in math and the assessment of various competencies have clearly been emphasized at the international, national, and state levels. In mathematics at the international level, for example, one would find volumes of data from the TIMSS assessments. At the national level one needed look no further than various reports regarding No Child Left Behind as well as ACT and SAT testing. Lastly, many states have had multiple end-of-instruction assessment strategies based on the completion of certain grade levels, specific courses or competencies. The teacher has been the primary individual given the responsibility to execute strategies to bring about success. To understand a part of that process, this study was designed to answer the following research questions:

1. Do teachers' decision-making strategies show evidence of intuitive utilization of cues?
2. What cues or combinations of cues were most salient to the teachers?
3. How statistically accurate were their informal predictions?
4. Are there any consistencies in decision making strategies among the teachers?

Definition of Terms

For this study, the following terminology will important to understand:

Intuition: Describes a complex series of processes and interactions within individuals. Tacit knowledge, cognitive structures, experiences, feedback loops, and emotions combine to direct the individual into a decision or plan of action.

Intuitive judgments: This phrase connotes a complicated interaction of mental and somatic processes which, when utilized allow the individual to make a decision or take action. Often these judgments are difficult for the individual to articulate, but none the less, guide them through their activities.

Cognitive Continuum Theory: Is a way to place cognitions conceptually along a continuum. This continuum ranges from purely analytical to purely intuitive.

Theory of task structures: This concept conveys the idea that every task has a set of unique contextual factors and inherent characteristics. Therefore due to such characteristics, the task can be theoretically placed somewhere along a continuum between purely analytical and purely intuitive forms of cognition.

Decision space: A phrase used to describe the resources available to an individual to make a decision. Resources include their own knowledge and prior experiences as well as any extant cues and observations perceived within that moment.

Complexity of Task: This phrase describes the characteristics of a given context. Examples of characteristics include the number of available cues, whether the cues were presented sequentially or simultaneously, and the degree of known or unknown intercorrelation among the cues.

Ambiguity of Task: How cues were organized or combined, the individual's prior experiences with the task context.

Ecology: The actual context or environment in which the decision is embedded in.

Policy: This term represents the individual's decision strategy. It actually consists of the ways in which they uniquely used the cues provided.

Form of Task Presentation: Characteristics of a decision context such as, the form or type of cues present, time constraints in which the decision had to be made and whether or not the task was more data-driven based on the present or memory-driven based on the past.

CHAPTER II

REVIEW OF RELEVANT LITERATURE

The purpose of this research study was to determine the effectiveness of math teachers' internal judgments regarding a student's future achievement. Methods were employed to present math teachers with typical student demographic and academic characteristics that they would encounter in their professional practice. Specifically, efforts were made to understand math teachers' internal judgments based on these characteristics or cues. The cues functioned as predictors and were used to predict math students' future achievement. Because this study is interested in how Algebra I teachers use intuition, a brief review of predictors of success in mathematics is also included. In order to better understand intuition and to further operationalize it as a construct, this chapter includes historical background as well as contemporary perspectives.

Along the more recent lines of inquiry in intuition research one finds the following themes: the role of pattern-recognition, heuristics and cognitive perspectives. Next, intuition will be reviewed in ill-defined contexts such as classrooms. Lastly, intuition is examined for its utility in the lives of individuals, specifically; novices and experts as well as transpersonal change.

Historical Roots of Intuition

From a historical perspective, the study of intuition and its development as a construct has a rich history reaching back to Plato (Johansson & Kroksmark, 2004; Noddings & Shore, 1984). Ultimately Plato believed knowledge was completed through the insight intuition provided about the world (Johansson & Kroksmark). The development of intuition continued to ebb and flow over the centuries. Around the middle of seventeenth century Renaissance thinkers began to realize that rational proofs and logical reasoning were not enough to solve problems individuals faced (Noddings & Shore). They focused on non-rational sources of knowledge. It was believed by some during this period that intuition was the construct that enabled one to have divine illumination. Others considered intuition as the substance that gave one a direct impression of what it was God wanted that person to experience or know (Noddings & Shore). A contemporary of Descartes' (Noddings & Shore), Spinoza (1955), felt that intuition was as valid and real as rational thought (Noddings & Shore). Intuition was the name given for a collective set of abilities. These abilities enabled one to reach beyond rational, systematic analysis of surface facts to deeper and potentially more meaningful, linkages and relationships Times were changing however, and the empirical emphasis of Newtonian thinking began to increase.

Although empirical analysis was method of choice during the Newtonian era, intuition was still being supported and promoted. It was thought, according to Kant (1966), that intuition was necessary for the very act of sensual perception to occur and an essential part of the overall cognitive process (Noddings & Shore). Intuition was an efficient source of useful knowledge about the objects one encountered in the world.

Eventually, Kant's work would later go on to influence the likes of Pestalozzi (1894), Froebel (1887), Jung (1962) and others (Noddings & Shore).

In the nineteenth and twentieth centuries, many educators and thinkers continued to develop the metacognitive aspects of the construct of intuition. Pestalozzi (1894) felt the focus of each lesson ought to direct sense impressions in order to then acquire meaning (Noddings & Shore, 1984). These sense impressions would be translated by the mechanism of intuition into knowledge or action and thus acquired further meaning. Froebel, built on Pestalozzi's work. He felt intuition was the ability that enabled the learner to grasp the meaning of symbolic representations and make meaning. In particular, it was one's physical context, and the events or activities contained therein, which was the catalyst for intuitive thinking. Intuition enabled the child, at the right moment, to take concrete objects and extrapolate them to larger meanings. The German philosopher, Arthur Schopenhauer (1969), followed a similar line of inquiry and felt that intuition was created by the mental representations from reality (Noddings & Shore). He argued for the idea that intuition was a direct link to the very core of an individual; their Will (Noddings & Shore). For Schopenhauer, this link to one's Will was directly responsible for integrating emotion and motivation with one's quest for meaning.

Intuition's ability to translate the objective world into deeper subjective meaning was thought to be done unconsciously and without direction (Noddings & Shore, 1984). Intuition transmitted perceptions meaningfully and purposefully, but without conscious awareness. Jung (1946) divided intuition into subjective and objective forms and approached intuition from both concrete and abstract perspectives. Abstract intuitions were thought to emanate from the Will instead of one's situation. Concrete, objective

intuitions came directly to the individual from the outside world. Jung emphasized that abstract or concrete intuitions were largely based on individual differences. What was intuitively abstract to one individual was concrete to another. It was believed later by some, based on more recent research, that all intuitions were initiated and directed by the Will (Noddings & Shore).

While Kant emphasized more of the purely cognitive aspects of intuition, Berne (1977), drawing on Jung's (1946) work, emphasized that intuition was derived from one's experiences and senses. Sometimes individuals knew something, but could not articulate it. As the individual attempted to solve problems, it was believed that the removal of large or even small amounts of uncertainty was considered possible.

Unfortunately, the removal of all uncertainty was seldom possible in the real-world context. Even those in field of quantitative analysis, an area that has been traditionally against intuitive styles of thinking, had addressed the issue of potential uncertainty. In quantitative forms of research procedures were created to deal with false positives and false negatives (Shultz & Whitney, 2005). Neyman and Pearson (1933) specifically addressed this principle when they discussed Type I and Type II error. They emphasized that the type and amount of uncertainty one was willing to deal with was related to one's social values. Although significant amounts of uncertainty or error could be reduced or controlled for, one could not eliminate all of it. Some within judgment research embraced this fact and labeled it "irreducible uncertainty" (Hammond, 1996, p. 14). Hammond (1996) stated:

> In short, irreducible uncertainty is an acknowledged fact in the subjective forecasts of the future behavior of physical systems in the natural environment, as

> well as the future behavior of political, social, and economic systems. For many, if not most, systems there is no means of prediction other than subjective judgment. (p. 19)

As dynamic and uncertain as real-world environments may have been, decisions still needed to be made. One of the areas of research, in the early days of judgment and decision-making, centered on Signal Detection Theory or SDT (Hammond, 1996). The basic theory came about in the 1950's and offered a way for researchers to grapple with uncertainty regarding potential errors and potential correct decisions. Both errors and precision increased or decreased in direct proportion to the amount of risk or uncertainty the researcher was willing to take. Intuition was considered the means to successfully navigate through such circumstances and deal with uncertainty (Hammond, 1996). Later, researchers in the domains of medicine (Ledley & Lusted, 1959) and law (Underwood, 1977) applied SDT to understanding how intuitive judgments were made in their own domains which often consisted of complex and dynamic decision spaces.

To function in such environments, the decision space needed to be viewed in a more casual, real-world way and not quite as mathematically as that articulated in Bayes' Theorem (Heider, 1958). Those who supported this view believed that decisions were made in contexts situated in a particular moment in time. It was believed individuals behaved based on whatever knowledge they possessed in that moment. Those who acted without knowledge of all things, and yet still made a decision, were said to have behaved intuitively.

This perspective was considered a corollary of Simon's (1991) idea of bounded rationality (Hammond, 1996). In this theoretical construct, the rationale for using

intuition was bound to or based upon the individual's approximated view of what happened around them in any given moment. This meant that the instance in which decisions were made was considered rational given extant conditions. If more information were provided to the individual from the situation or if the individual possessed more knowledge, intuition would have been less necessary and decisions may have been different. Decisions made in these provisional, uncertain situations were just the opposite of those situations supported by more, deterministic views. Instead, real-world problems required the individual to use intuition in order to function by filling in gaps and connecting seemingly disparate pieces of information. Operating in such contexts was referred to as "conditional indeterminism" (Hammond, 1996, p. 16).

Conditional indeterminism connoted the idea that, in these conditions, the judgment that was made was done so because of irreducible uncertainty at that moment. This revealed a time-dependent feature of real-world decision-making. The construct of intuition allowed researchers to encapsulate the sum total of all that a moment possessed, including the individual. Intuition therefore provided a systems view of decision behavior. At any moment two systems coexisted, simultaneously. Within the decision space there exists the external world or context with its dynamic set of elements, but also within the decision space was the internal world of the individual which consisted of personal and professional components (Hammond, 1996). Because the external world consisted of irreducible uncertainty, it produced uncertainty in the individual's internal, cognitive systems. It seems clear that intuition is activated within the fuzzy space between one's external context and the cognitive apparatuses one used to apprehend that context.

Development of the Cognitive Continuum Theory

Intuition as a multi-faceted construct did not deny experience, data, or the use of analysis. Instead it merely translated how these components were utilized. It seems clear from the research that those who used intuition did not do so at the expense of analysis. Indeed, it is believed that every problem required some analysis and some intuition (Hammond, 1996). It was the emphasis on how decision contexts were organized that led Hammond (1996) to develop the "Cognitive Continuum Theory" or CCT (Cooksey, 1996a, p. 13). This theory, nested within the larger Social Judgment Theory, simply stated that each situation had a corresponding form of cognition, an idea originally referred to as the "theory of task structures" (Hammond, 1996, p. 180). This meant that the decisions one faced could be categorized and placed along a continuum based upon the type of cognition they induced. This continuum ranged from purely intuitive to purely analytic. This concept was explicated as a way to emphasize that every problem had some intuition and some analysis. CCT was built upon five premises. Each premise addressed certain characteristics of decisions. The five premises are as follows: cognitions can be placed along a continuum, the concept of quasirationality, types of decisions can be classified, oscillations in thinking and the role and use of patterns.

The first premise states that modes of cognition could be placed on a continuum ranging from pure intuition to pure analytic thinking. Hammond (1996) was concerned about the prevalence in psychology to unnecessarily dichotomize analytic and intuitive cognitive modalities. Hammond felt every decision involved a little intuition and a little

analysis. He believed decision-making was inclusive of seemingly apparent extremes rather than favoring one or the other.

The second premise emphasized the space between these poles. This Hammond (1996) referred to as "quasirationality" (p. 150). According to Hammond, the concept of quasirationality was similar to Simon's (1986) explication of bounded rationality and Heider's (1958) concept of common sense. Hammond continued when he articulated compelling arguments for the long history of quasirationality and the obstacles to analytical cognition.

The third premise stated that decision-making task could even be classified by being placed along the continuum based on the type of cognition they were likely to produce (Cooksey, 1996a). Hammond (1986) grouped decision tasks characteristics into three groups. They were "complexity of task", "ambiguity of task", and "form of task presentation" (Cooksey, 1996a, p. 13). Complexity of task dealt with characteristics such as the number of available cues, whether the cues were presented sequentially or simultaneously, and the degree of intercorrelation among the cues, etc. (Cooksey). Ambiguity of task dealt with how cues were organized or combined, the individual's prior experiences with the task context, etc (Cooksey). Lastly, form of task presentation involved such characteristics as the form or type of cues present, time constraints in which the decision had to be made and whether or not the task was more data-driven based on the present or memory-driven based on the past (Cooksey).

The fourth premise acknowledged that cognitive activity cycled from analytic and intuitive modes as a function of time (Cooksey, 1996a). Hammond (1996) believed time constraints served as a catalyst for shifting decision processes along the continuum. For

example, he found that if the subject had little time, he or she tended to drift into more intuitive modes. Another catalyst for shifting modes of thinking was the subject's success or lack thereof. Cognitive behaviors that produced successful results tended to be reinforced. If he or she was unsuccessful, the individual's cognitive activities moved toward the opposite end of the continuum. In order to move from one pole to the other, one must pass through the middle area of the continuum considered quasirational. This was the area, Hammond believed, in which tasks possessed combinations of both intuitive and analytic forms of cognition. Regardless of where a decision task ultimately ended, Hammond reinforced that such "oscillations" (p. 195).ought to be expected

The fifth and final premise addressed the human capacity to form and utilize patterns of extant cues in order to make judgments. This premise emphasized use of global patterns or gestalts. The idea of pattern utilization went largely ignored until re-introduced in the 1970's and 1980's (Kahneman & Tversky, 1972; Margolis, 1987;). Hammond (1996) emphasized that pattern utilization may be best used in certain situations. Specifically, he felt it was best used in circumstances that offer recognizable coherence to either the untrained or more seasoned individuals.

Early in its history intuition was referred to as "common sense psychology" (Heider, 1958, p. 5). Efforts were made to defend intuition in the face of those who valued more rigid, analytical means of discovery. To that end, some posited that the goal of data one discovered during traditional, positivistic scientific research, ultimately had to still satisfy the researcher's own common sense (Whitehead, 1929). Common sense represented the area on a continuum between the two extremes of purely intuitive cognition and purely analytical cognition (Hammond, 1996). Common sense was

essentially the layman's term for "quasirationality" (Hammond, 1996, p. 161). This form of cognition was believed to be rooted in man's evolutionary, adaptive ability (Simon, 1991). These terms represented a complex of processes to describe the way individuals intuitively reached internal consensus when they were in ill-defined situations.

A benefit of viewing intuition in this way was that, when used in real-world problem-solving contexts, it essentially allowed the intuiter to be flexible and use extant, observable behavior and occurrences as an indicator of the real unseen forces at play (Hammond, 1996). This made the decision process faster and more efficient and did not require time consuming analyses. The underlying forces represented real issues believed, by the intuiter based on their experiences, to be related to the goal of their cognitive efforts. This ability for items to be substituted for other, deeper related mechanisms was what Hammond (1996) called "vicarious functioning" (p. 115). Although analysis provided precision for a specific, tightly defined set of parameters, intuition provided a level of robustness. It afforded cognitive systems degree of flexibility over a wide range of conditions. Intuition increased the utility of an individual's cognition and maximized whatever level of expertise they possessed. Depending on the situation, an individual's thinking processes oscillated within the intuitive-cognitive continuum, varying the types and degree of cognition. It was believed that these oscillations were driven, by internal forces, in an effort to achieve emotional satisfaction. Cognitive efforts that oscillated toward the intuitive end of the continuum tended to occur when the context was one of discovery. This movement represented something Hammond referred to as "dynamic cognition" (p. 192). The catalyst behind the cognitive shift occurred when the individual was unsuccessful. However, when successful, the individual tended to keep the cognitive

style the same. When situations were only partially understood or ill-structured the individual's decision was defined or bound by that context.

As a result of these early efforts, the stage was set for research to be conducted to understand the construct of intuition further. The amalgam of processes involved in intuition began to be researched as structure that assisted the intuiter in both storing and recalling information as well as the execution of skills. Researchers wanted know what these processes were and how they worked in concert to produce what is considered the construct of intuition.

Intuition and Pattern-Seeking

One significant area researched was the linkage between intuition and pattern-seeking. Some researchers felt intuition was elicited by patterns based purely on factual comparisons between separate events. Others however, researched patterns based not so much on upon the similarities content, but on similarities of emotions. Either way those in this particular area of research wanted to understand how patterns encouraged the transference of information.

Research that approached intuition from the factual, non-emotional perspective considered pattern-recognition to be driven by analogous thinking. This form of thinking was believed to be used to identify factual elements from the new setting based on the understanding of identical elements from previous encounters. It seemed one's initial experience with a given situation or phenomenon essentially became the source concept from which future actions originated. These efforts did not imply deep, timely analysis had occurred. Instead this intuitive-inducing mechanism occurred in quick flash-like

comparisons. Using such a technique, one simply took these previously stored source concepts and attempted a best-fit approach to events experienced in that moment. Individuals believed that if they made a successful decision in a prior situation and were later confronted with a similar scenario, they could intuitively apply the same thinking as before in the hopes of achieving similar, successful outcomes. It is believed these experiences established the parameters for a pattern-matching form thinking which was both quick and efficient (Kolodner, 2002).

Understanding intuition from a core process such as pattern-recognition was furthered by what English (1993) described as a "feature-detection model" (p. 391). In particular, English believed this model was a part of a larger theory of attention and that it accurately depicted the cognitive processes often referred to as intuition. It was viewed that some models of intuition only focused on a situation being recognized by the individual. English however shed light on additional internal activities involved in eliciting intuition. It was posited that within a given context, observation of a pattern was followed necessarily by identification which then required further confirmation before it could ultimately have been diagnosed. Therefore, when internal expectations and features were either mismatched or novel compared to features from one's present, external observations, the individual was encouraged to attend toward the issue. Due to the potential novelty or danger of the situation the person had "gut-feelings" (English, 1993, p. 390). This sensation was a real, biological consequence. English described it as a somatic reaction to psychological activity which was actually a sympathetic stimulation of the autonomic nervous system.

The ability of feature-detection to essentially initiate intuition was found to provide further benefit in dynamic, poorly-structured environments (Farmer & Page, 2005). One example where this was seen came from educators in the medical education field who incorporated feature-detection as a means of teaching physicians to intuitively make decisions (Farmer & Page). It was believed in any significant situation, even ill-structured ones, there resided the critical elements necessary for a successful outcome. Therefore, it is because of these environments that intuition initiated especially if practitioners were trained initially to detect such key features. King and Appleton (1996) agreed that feature detection was a source of knowledge, amassed from one's experiences that caused the intuitive process to be set into motion. They believed these experiences were developed both formally, such as within classroom training and informally, such as one's professional practice. This line of inquiry into intuition seemed to suggest that individuals applied personal and professional knowledge gained from experience to intuitively enhance typical, linear decision-making processes. These prior experiences became an efficiently internalized, tacit set of features to which all future events were compared. This allowed for the streamlining of the decision process and hastened action. One essential element discovered in feature-detection is the necessity for contextual feedback. Contextual information, when relayed to the individual, equipped that person with the necessary "features" to focus on. One way in which patterns of prior experiences become so useful to individuals is based on the specific feedback they provide.

The Role of Feedback in Developing Intuition

In order to be intuitive or to develop intuition, one needs feedback from one's experiences. It appears that intuition, although robust and flexible once matured, is especially sensitive in its development. Even though feedback is necessary to develop intuition, it does not always contain the same quality or occur with regular the nature and quality of a prior experience as well as the feedback associated with it, was not always consistent (Hogarth, 2001). Intuition was contextualized within the environments in which one experienced something. This entire package, otherwise known as a "learning structure," possessed its own characteristics (Hogarth, 2001, p. 88).

Learning structures along with the experiences and the feedback associated with them were said to come with a qualitative disclaimer. Not all experiential events were beneficial or accurate in fostering intuition (Hogarth). When developing intuition one needed to see accurate linkages between antecedents and the phenomena they were related to. Environments in which this occurred could be "kind" or "wicked" (Hogarth, 2001, p. 88-89). Kind environments were contexts in which the cause of a phenomenon was easier to ascertain; while wicked environments, to the contrary, were elusive, misleading, confusing and even erroneous. Therefore both environments were described by the amount of accuracy they contained (Hogarth).

Not only is accuracy of the experience examined, but also the manner in which feedback is delivered. Both kind and wicked environments are described by this characteristic. Kind environments have feedback which is timely, helpful and relevant. Hammond felt this was superior and referred to this as "cognitive feedback" (1996, p. 270). This kind of feedback was delivered quickly and precisely, but also provided

rationale for the interrelationships among objects in one's decision space. High-quality feedback provided factual information that was able to be extracted and stored in a particular way in order to form high-quality schema.

Wicked environments had feedback which was delayed, over-generalized and misdirected. Hammond considered these forms of feedback as "outcome feedback" (Hammond, 1996, p. 270). This was merely a cause and effect style of feedback. Due to the nature of the often delayed feedback inherent in these contexts, learning from them and thus the formation of intuition was difficult at best.

The importance of both the accuracy of the situation and the feedback which accompanied it fundamentally meant one's intuitive prowess was built upon overall situational clarity. Clarity was a qualitative by-product of both the nature of the feedback context and the consequences of errors (Hogarth, 2001). Feedback provided clues to the phenomenon's relationship between cause and effect or action and reaction. These relationships were then encoded as schema necessary for intuition to be implemented as a viable decision-making alternative. Intuitive thinking used schema stored based upon the degree of category membership, their connection to event concepts and the ability to transfer prior learning to similar, future settings (Anderson, 2005). Once the components of understanding individual judgment were established, research efforts began to shift from formation of intuition to its implementation.

As research continued in the area of patterns and intuition, it was observed that one's emotion had a larger role to play. It seemed emotion possibly guided and facilitated one's ability to match internal patterns with external observations. The power of this emotional sensation may have been what Berne (1977) referred to when he wrote about

how intuition had the power to convince individuals and that this feeling was a key confirmatory response. Such visceral feedback was used by the brain in order to continue with a particular course of action.

Emotions and Pattern-Recognition

In recent lines of inquiry, others have agreed that the appeal of intuition was based, in part, on the feelings and emotions involved and their power to elicit satisfaction within the decision-maker (Easen & Wilcockson, 1996). The use of one's intuition had a confirmatory feedback aspect to it. Berne (1977) believed individuals acted, after the fact, as if they knew the solution all along based on the convincing power of emotions inherent in the use of intuition.

It is posited that some usages of intuitive forms of thinking are based on the emotional reactions of individuals. These emotional mechanisms, in turn, facilitated heightened cognitive processing as a result of the personal nature of the decision setting (Louie, 1999). Research into intuition therefore was believed to be some meta-process derived from, but surpassing, the sum total of one's emotional and cognitive processes (Bastick, 1982). Research began to be conducted on the combination of one's observation within the decision space along with the emotional sensations associated with a goodness of fit with one's decision. This line of inquiry led specifically to research on intuitively perceived patterns.

Pattern-matching is, to be sure, a core mechanism involved in intuition (Bastick, 1982). However, this cognitive ability to match patterns between prior and current situations is believed to be catalyzed by the similarity of emotions between the two

events. Therefore, some felt that similar emotions actually initiated the pattern matching of subsequent events with prior experiences. This led what Simon and Kadane (1975) referred to as "satisficing" (p.235). They felt that intuition was a powerful force that essentially satisfied certain internal and even unconscious criteria. Once these criteria were met there was a visceral sense of feeling satisfied and that one's chosen course of action was the best alternative. This facilitated the retrieval process of various schema from long-term memory (Bastick). In order for intuitive decision-making to work, emotion needed to take preeminence as the catalyst necessary start all cognitive and executive processes (Damasio, 1994; LeDoux, 1996).

This shed light on understanding the interaction of intuition with the storage and retrieval of one's experiences (Burke & Sadler-Smith, 2006). It was believed that the act of storing and retrieving was considered the act of intuition. The intuitive recall and implementation of stored schema was believed to be based on recognition-primed cues, analogous thinking, and pattern matching (Bastick, 1982; Benner & Tanner, 1987; Kaufmann, 2001; Kolodoner, 2002). Indeed, cue recognition and utilization was a critical mechanism inherent within Brunswik's (1952) judgment theory.

Intuition is a way to explain several of the cognitive activities involved in both the awareness of a situation and the retrieval of skills or knowledge in order to execute a script or decision (Klein & Herman, 2003). Intuition is an unconscious process in which knowledge and perceptions are first emotionally registered in the subconscious. This is then followed by conscious verbalizations of the original perception in order to produce an action (Berne, 1977). Although emotion appears to be a driving force, further inquiry reveals deeper roots which appear to guide one's emotions; namely one's beliefs.

One's Beliefs and Intuition. One theory suggests that emotions necessary to catalyze cognitive and psychological processes involved in making intuitive decisions are actually shaped by the teachers' beliefs (Long & Stuart, 2004). In order to improve a teacher's intuitive decision-making, real, cognitive change needs to occur. Cognitive change would only occur when teachers reflect on their beliefs and decisions. Beliefs were significant to Brunswik's (1952) initial theory because they often served as a mechanism filtering one's perceptions of available cues. As a result, reflection and decision-making were essential because they became the means necessary to change beliefs in order to change one's practice (Long & Stuart). The development and use of intuition could be difficult to change because one's beliefs were based upon one's experiences. Beliefs however, had a feedback mechanism, and as a result not only affected intuitions in that moment, but influenced the interpretation of future experiences. Therefore, future intuitive experiences are filtered based on prior beliefs. Intuitive decision-making allows for potentially valuable feedback loops, which either confirmed or disconfirmed one's actions thus modifying belief and improving intuitive ability (Argyris, 1991).

Heuristics and Intuition

Another way intuition is operationalized is based on the understanding of something referred to as "subjective probability judgments" or heuristics (Cioffi, 1997, p. 203). This form of making judgments is used in specific situations and possesses certain characteristics. These probabilities create a set of odds that individuals processed unconsciously when answers or options were not easily identified. Probability judgments

are used in uncertain situations, without reasoning or analysis, and depend on prior experiences. It is believed that actions taken in previous experiences are organized and recalled based on the certain elements of what was experienced in subsequent events. Based on those experiences, individual intuitively sized-up their present situations and moved forward based on some internal set of probabilities. Three versions of heuristics were proposed as possible explanations for the set of processes known as intuition; representativeness, availability, and anchoring and adjustment.

The first was referred to as the "representativeness heuristic" (Cioffi, 1997, p. 206). This intuitive method involved the assessment of characteristics currently experienced in a given instance with those of the larger phenomenon (Cioffi). Essentially, to make a decision, the individual gave intuitive consideration to how similar or dissimilar the present situation was to prototypical examples of the norm. Based on the degree of deviation, a particular decision was made. This intuitive method tended to be used when the context was focused on general, consistent properties.

The second form of heuristic was referred to as "availability" (Cioffi, 1997, p. 207). This form of intuition based comparisons of current to past experiences by noting the ease at which exemplars could be recalled (Friedlander & Stockham, 1983). The key mechanism when this form was being used is saliency (Cioffi). It is salience that brought the prior experience of the individual into cognitive proximity with the present situation. Not only is ease of recall key to initiating intuition, but also ease of computation (Cioffi). It is believed easily computed solutions were perceived as more common, thus, more probable. Based on these probabilities and the ease or accessibility to embedded information, a decision is made.

The last heuristic used to describe intuitive processes is referred to as "anchoring and adjustment" (Cioffi, 1997, p. 207). This method involves the individual possessing a pre-existing understanding of the phenomenon in question. Such experiences serve as the anchor for one's understanding of a given phenomenon. The adjustment, and therefore the decision, is then made based on the amount of deviation between the various anchor values and the particulars of the present situation.

Cognitive Perspectives on the Construct of Intuition

Much effort has been placed in understanding the psychological and cognitive substrates composing intuition (Agor, 1989; Claxton, 1998; Hogarth, 2001). Metacognitive structures essentially facilitate intuition by functioning as a source for thought management and monitoring (Kuhn & Dean, 2004). These reflective acts allowed one to make intuitively guided comparisons and decisions among competing choices. For Kuhn and Dean, the intuitively guided nature of such comparisons resulted from linking metacognition to cognitive structures. These structures were, in turn, held in check by executive control. As a result, executive control organized various information and sensory networks involved in utilizing emotion, memory and pattern detection to essentially form the construct known as intuition. The simultaneous use of these various networks allowed an individual to intuitively use stored information from previous experiences in order to solve situations faced in that moment. The utilization of information patterns gained from sensory networks and stored within cognitive structures of the brain led to linkages being investigated between intelligence and intuitive prowess.

The Interaction of Intuition and Intelligence

Discovering the underlying mechanisms teachers used in intuitive decision-making appears to have caught the attention of several others in the field of education. One criticism proponents of intuition faced was in being able to explain its interaction with intelligence and memory (Sabers, Cushing & Berliner, 1991). It was believed that intuitive decision-making was directly linked to the quality of one's memory and that those who used it were generally higher than average in intelligence. Therefore, it was believed, that the ability to be intuitive may be out of the control or reach of certain individuals. To better understand this, researchers studied the ability for teachers to make sense of the multiple layers of incoming stimuli present within a classroom. This was important because if information was not attended to properly by the use of one's memory and intelligence, schema development would be difficult at best (Sabers, et al). As result, it was believed that intuitive recall and execution could never occur. Researchers were able to determine however, that good decision-making was not causally linked to intelligence or memory only (Sabers, et al). Rather, intuition appeared to be the nexus of not only intelligence and memory, but other mitigating, cognitive processes. For example, one's ability to use syllogistic thinking, symbols, concepts and abstractions as well as the individual's motivation mechanisms were found to be involved in being intuitive (Haywood, 2004). The simultaneous combination of these items had global effects on one's ability to use intuition to problem solve, think, learn and even perceive. What was evident from this line of inquiry was that various sensory and cognitive mechanisms were significant in the sense that they provided a way to process external

feedback. This, in turn, is a key step in developing and indeed, using, intuition in complex environments.

Intuition Used in Ill-Defined Contexts

Decision-making that involved sifting through overlapping and competing pieces of information within fast paced environments is considered the primary rationale for using intuition. Individuals in fields such nursing, business and education place importance on the use of intuition because they all shared similar, ill-structured environments (Rew, 2000). Such contexts minimize the rigid use of formulaic decision-making in favor of more flexible systems (Burke & Sadler-Smith, 2006). It is believed that analytic, rule-based, decision-making paradigms fail because the classroom setting is in a constant state of indeterminacy. Burke and Sadler-Smith noted that while rational approaches were well known for working in well-defined contexts their limitations were equally well known when attempting to solve ill-structured problems. The inherently ill-defined characteristics of the classroom environment appeared to be the real weakness of rational, decision-making approaches. Schön (1987) addressed the indeterminate, shifting nature of classrooms by arguing that the real problems found in classrooms do not neatly present themselves as tidy, well-defined scenarios. Decisions made in these contexts were done so often times with partial, contradictory and confusing cues. Researchers operationalized intuition by explaining that it was a synthesizing process when, once the individual was convinced, he/she followed through with a conscious decision to act. Actions emerged as one became more aware of the present situation and attempted to synthesize it with something they may or may not have experienced. Ultimately, even

though intuition consisted of separate elements such as empirical, ethical, aesthetic and professional knowledge, it was the act of synthesizing which caused it all to be perceived as a unified whole. Both the process of synthesizing and its outcome may have been difficult for individuals to describe. Intuition itself served as a bi-directional conduit for the teacher to use in order to perform with purpose as well as receive and reflect on feedback from the classroom. It was believed that individuals in such settings could be encouraged to implement intuitive problem solving as a means to enhance thinking processes and thus decision-making (Bruner, 1977). Making decisions is not simply action-reaction or cause-effect dyads. Rather, it appears that the making of good, intuitive decisions involves overlapping mechanisms resident within the individual and elicited by situation.

In educational research, much effort has been placed on understanding the classroom environment. Intuitive teachers need to take into account several contextual factors inherent within the classroom. One finding described the characteristics of incoming stimuli teachers had to manage as “multidimensionality” (Sabers, et al., 1991, p. 1). This was defined as the inherent nature and diversity of cues which occurred within the classroom at any given moment. The depth and breadth of cues occurring within a single space of time could be difficult, at best, to quantify. Teachers utilize vast quantities of cognitive function, such as working memory, as they processed large amounts of information (Hinson, Jameson, & Whitney, 2003; LeDoux, 2002; Sabers, et al., 1991). Unfortunately, teachers do not have the luxury to individually analyze each cue by itself. This lead to a second finding referred to as “simultaneity” (Sabers, et al 1991, p.1). This was defined as the need to analyze all incoming streams of data at the same time. In other

words, teachers did not have the luxury of picking and choosing individual streams of feedback to carefully monitor and process. They were receiving dozens of cues at the same time. The last finding was referred to as “immediacy” (Sabers, et al 1991, p. 1). This concept referenced the quick pace at which teachers must monitor information. It essentially described the speed at which incoming information confronted the teacher. Ultimately, the research by Sabers, et al painted a picture of teachers who must work through vast amounts of seemingly disparate information at a rapid pace and do so all at the same time.

It is posited that in order to be intuitive in these situations, the teacher has to become a rapid, yet reflective decision-maker (Colton & Sparks-Langer, 1993). Those teachers who merely possessed and implemented technical skills were not enough. Instead teachers, through intuitive means, were believed to quickly incorporate a larger, more multi-faceted view of the decision-making space. Specifically, Colton and Sparks-Langer felt that intuition enabled the teacher to combine ethics, morals, democratic principles, and best practices into their professional planning and decision-making. The construct of intuition incorporated these elements and is the means by which teachers systemically changed the ways they did things.

Another ill-defined, professional context is nursing and nursing education. Research conducted into the use of intuition within the field of nursing education emphasized that experience and feature-detection facilitated the development of intuition (Benner & Tanner, 1987). Intuition assisted the practitioner to note how present situations were similar or dissimilar to those previously encountered. Therefore, as a matter of efficiency, nurses used their intuitive skills to decipher what may have worked before and

whether or not it may be appropriate to what was being observed. Intuition enabled one to not only see the facts of an illness, but yielded a meta experience that provided a real "grasp" or "understanding" of the context (Benner & Tanner, 1987, p. 25). It was believed that the genuine care and aid supplied by nurses often produced the impetus to actually use intuition. This pathos was similar to Bastick's (1982) perspective that the similarity of emotions between two separate events initiated the use of intuition. It was often the nebulous, inexact nature of the nursing context, and not one's lack of expertise, which caused intuition to be implemented (Benner & Tanner). As a result, vague contexts drew upon whatever experience an individual had through the conduit of intuition to produce salience (Benner & Tanner). Salience was then a key component of intuition and enabled the individual to quickly build a case for what to do next. Often these plans were more accurate than checklists due to contextual specificity (Benner & Tanner). This focused performance allowed the individual to function in a smooth, fluent manner due to filtered, extraneous stimuli.

Expertise and Intuition

As researchers continued to examine how professionals used their intuition, efforts were made to investigate its relationship with novice versus expert levels of experience. A certain, perhaps underdeveloped, level of intuition appeared to naturally grow based on years of experience (Hogarth, 2001; Rew, 2000). However, beyond merely working for years in a particular field, it was evident that what was most significant in developing intuition was in how one's thinking changed from those experiences. As one's thinking changed it often became more efficient and intuitive. Thus

the discussion of expert versus novice was frequently paralleled with certain types of thinking; analytic versus intuitive. The belief was, as one amassed years of experience, one developed intuitive thinking. Meanwhile those who were beginners and performed at novice levels were usually more analytic. It seemed apparent from the literature that early in the process of developing intuition, analysis would be more appropriate in order to understand the elements of the decision context. However, the research indicated intuitive thinking could and should be used by novices if they wanted achieve the highest levels of expertise and success (Dreyfus & Dreyfus, 1984). In fact, it was emphasized that one's ability to achieve expertise was only possible when the analytic mind was quieted and intuitive thinking was encouraged. Doing so allowed many of non-conscious processes, an area were many feel intuition was derived, to be put into action. Some believed that efforts made to find or develop rules for behaving and acting were inefficient and actually stifled intuition. Instead of expending mental resources to solve the problem using rules and formulae, it seemed complicated problems were best resolved when intuitive, implicit, non-analytic methods were utilized. High levels of performance did not equate necessarily to one possessing larger libraries of rules, procedures and background knowledge. Instead, high-performers, regardless of experience, exercised intuition when they exhibited spontaneous, holistic application of knowledge represented in the form of an action in a specific context. There was no need for a laborious, pattern-matching analysis. Instead, intuition was from a metacognitive act that allowed the individual to utilize and maximize whatever tacit knowledge they possessed.

Because of the holistic, seemingly casual, nature intuitive individuals utilized tacit knowledge, some viewed it as an irrational activity (Dawes, 1988). Some felt that experts

did not achieve their status purely because they knew more information (Hammond, 1996). Rather those who used intuition appeared many times to be unable to explain why they believed what they believed. For the intuiter, intuition was an instant, simultaneous perception of all the elements within the context. This perception, though based on prior knowledge, was without the user's ability to expressly identify a conscious awareness of neither specific, contextual elements nor the past experience in which they were originally obtained (Lieberman, 2000). Their knowledge base was fine-tuned and built upon previous patterns and experiences in order to cause their performance to take on tacit or intuitive qualities. This inability to explain how or why they came to their conclusions, regardless of expertise, was perceived as erratic and thus caused the devaluation of intuition (Easen & Wilcockson, 1996). Proponents emphasized that expertise, when synonymously linked to intuition, should be criticized. Further, some felt intuition was an overgeneralization used to depict, and indeed mystify, experts who acted expertly (Easen & Wilcockson). Instead, intuition could be used by all individuals to varying degrees. Such thinking led to research being conducted to determine the non-experientially based aspects of intuitive individuals.

One way this was done was by classifying intuition as simply a form of thinking used independent of one's expertise. In particular intuition was linked to the information processing approach to cognition (Ruth-Sahd & Hendy, 2005). It was believed information processing was the means by which stored experiences were compared with current situations. Some research found that one's proclivity to use intuition was based on experiences, but not necessarily those associated with their profession-based expertise only. In particular, Ruth-Sahd and Hendy noted the following characteristics appeared to

be common with those who utilized intuition regardless of their level of expertise: older in age, female in gender, high confidence in their own judgments, an openness to spirituality, an openness to using intuition in decision-making, maintained strong, supportive connections among friends and coworkers, and, in most cases, tended to exercise empathy. In particular, this last trait appeared to develop from instances when the intuiter perceived similarities between current contexts and their own, personal history (Ruth-Sahd & Hendy).

Some believed intuitive forms of thinking were activated when one merely changed or re-framed their perspective (Yusko, 2004). In particular, reframing the problem along with the employer's social and professional acceptance of intuition, actually served to guide the individual in knowing when the situation called for purely intuitive, quasi-rational or purely analytic methods (Hammond, 1996). Part of being able to reframe a problem involved one's ability to ask questions in order to maximize any possible information contained in that instance.

Intuition provided the ability for the intuiter to extract meaningful knowledge from all experiences and utilize the best mode of thinking. Rather than merely experiencing an event, one's intuition enabled the individual to evaluate and organize the particulars of the event in order to be stored and called upon again in the future (Leners, 1992). Although one's level of experience has always been an issue when intuition was studied, it was clear that it was not the defining issue (Ruth-Sahd & Hendy, 2005). Ultimately intuition came to be viewed as a mechanism that contained rational and seemingly irrational processes based upon one's level of expertise. Intuition was a legitimate decision-making process with results that could be easily validated and

portrayed as an efficient, non-linear process that allowed for speedy and effortless action (Easen & Wilcockson, 1996).

Intuition Viewed as Skill and Not a Gift

As a result of being taken out of the exclusive hands of experts only and a broadening of how intuition is developed, intuition began to be viewed as a skill one could learn. This emphasis represented a shift in intuition research. Part of this shift was based on attempts to de-mystify intuition and take it out of the hands of the few who, it was believed, appeared to have achieved some special status. That perception placed intuition out of reach for the masses and in the realm of being nearly considered a gift one was born with (Ruth-Sahd & Hendy, 2005). Thus began efforts to focus on intuition as a construct defined by a constellation of personal and professional skills in addition to experiences.

In order to approach this construct from this perspective, the definition of intuition needed expanded. One such definition reflected the balance between personal and professional skills as well as the value of one's level of experience. Rew (2000) defined intuition in the following way:

> [Intuition] is the act of deciding what to do in perplexing, often ambiguous and uncertain situations. It is the act of synthesizing empirical, ethical, aesthetic and personal knowledge. Stated another way, intuitive judgment is the decision to act on a sudden awareness of knowledge that is related to previous experience, perceived as a whole, and difficult to articulate. (p. 94)

When, for example, intuition was used by novice nurses, several themes within the group's skill-sets arose (Kosowski & Roberts, 2003). In particular they found that intuition consisted of frequent reflection, confirmation or data gathering based on initial hunches, knowing the rules of the organization and following chain of command protocols, learning from situations that enhanced their intuitions or inhibited its fullest expression and lastly, they took physical, mental, emotional, and psychological care of themselves (Kosowski & Roberts). Maintaining good psychological health was an activity deemed necessary in order to remain caring and sensitive; a trait others have identified as a real catalyst for intuition to flourish (Noddings & Shore, 1984). The iterative use of these skills allowed the individual to reconfigure and streamline professional activities by making better observations, and a nearly instantaneous analysis of what happened. The success of the decision, allowed the intuiter to validate their use of their intuition and further the personal, emotional investment by trusting it more.

Intuition and Transpersonal Change

Intuition not only produces results within the immediate context by leading to good decision being made, but has additional, large-scale implications which extend beyond the situation. It seems intuition has a transpersonal component with its ability to impact society by bringing individuals together at a deeper level (Fuller, 1973). For example, when intuition's use was studied in the nursing field, researchers determined the following: it deepened nurse-client relationships, lead to a better understanding of patterns of patient health, showed the influence and benefits of agency and assertiveness in the nursing field, exposed how nurses handled the emotions involved in taking

professional risks, and how it contributed to overall quality of nursing care. It seemed that intuition not only had external expression in the form of decision-making, but also produced internal benefits within and between the individuals involved.

Intuition appeared to both cultivate the depth of the connection between the intuiter and the object or individual they were working with (Leners, 1992). This connection allowed the individual who utilized intuition to have a better understanding of the situation. Intuition provided depth to observation and understanding. Such intensive awareness of the situation provided new knowledge and insight into the experience. Enhanced levels of understanding then allowed the intuiter a perspective that only encouraged usage of intuition and improved decision-making. This cyclical feedback and transpersonal nature of intuition afforded one the ability to see patterns in more meaningful ways. This, in turn, depth of understanding provided better precision and robustness in decision-making.

Summary of Intuition Research

Individuals have always needed to make decisions of one sort or another. Some decisions are rather simple with few factors to consider. Other decisions however, may have been made in quite complicated contexts with numerous individuals and equally numerous outcomes potentially involved. Regardless of the context though, fundamentally, the act of making a decision is the act of removing as much of the unknown as possible. This allows the individual to deal with the remaining irreducible uncertainty (Hammond, 1996). Intuition is the vehicle to deal with residual uncertainty and was the focus of this study. Efforts have been made to find ways, using mathematic

or analytical means, to enable decision-making to be as fool-proof as possible. They have used these means to reduce as much uncertainty in the decision space as possible. Individuals in this deterministic camp believed that if all things could be known, then the prediction would be a simple and exact process every time (Hogarth, 2001). It was believed that within the decision space, the individual was considered the weakest link. The goal was consistency and automaticity in making decisions by removing the fickle human element and allowing mathematical laws to prevail.

This study attempted to show that the construct of intuition was a valid way to bring about success by taking advantage of human flexibility in dynamic and shifting contexts. Hammond (1996) pointed out, that higher levels of precision in decision-making by using purely analytic or formulaic means actually revealed the fragility of such processes. Mathematical means of making decision were fragile due in part to the real-world environment of the human and the decision space. The elements in such contexts are not consistent and lab-like, thus ameliorating the coveted generalizability feature so many researchers strive to obtain. The use of intuitive means of making a decision provided a robust option that enabled the intuiter to adapt to the situation and take advantage of their innate ability to be flexible. A functional understanding of the relationship or gap between these two systems was effectively explained by the construct of intuition.

CHAPTER III

METHODOLOGY

The purpose of the study was to investigate how teachers utilized student demographic and academic information to make judgments about future performance. Both demographic and academic data were considered cues. The cues served as a set of predictors for the teachers. Each student's set of cues became a profile and was used to estimate that child's future achievement on the Oklahoma Algebra I end-of-instruction (EOI) assessment. The following cues were taken from school records: grade point average (GPA), gender, ethnicity, and socioeconomic status as determined by whether or not the student received free or reduced lunch. School officials assisted with obtaining the final cue of math self-concept. They administered an instrument to measure academic self-concept in math. The method chosen for this study was rooted in Judgment Analysis literature (Cooksey, 1996). The particular theoretical framework utilized for this study was Social Judgment Theory and originated from the work of Hammond, Stewart, Brehmer and Steinmann (1975). This chapter provides detail regarding the overall design of the study including participants, instrumentation, and procedures.

Participants

Participants were current and former middle school and high school math teachers from a school district in a midwestern state, teachers known to the researcher, and others

recruited by participants using the snowball method. Appendix A shows the necessary IRB documents regarding this study. There were 15 participants total. The sample consisted of 20% (n = 3) male and 80% (n = 12) female. Among the participants there were 2 Native Americans and 13 Caucasians. Regarding certification and credentials, 13 were traditionally certified, 1 was alternatively certified and 1 was a National Board Certified Teacher. Additional descriptive information on the participants can be found in Table 1.

Table 1

Demographic Information for Participants

Age	
18 – 25yrs old	3
26 – 33yrs old	4
34 – 41yrs old	0
42 - 49yrs old	2
50+	6
Total Years of Teaching Experience	
1 – 3yrs	4
4 – 6yrs	3
7 – 9yrs	1
10 – 12yrs	0

Table 1 (continued)

13 -15yrs	1
16 – 18yrs	1

Table 1 (continued)

19+ yrs	5
Total Number of Years Teaching Pre-Algebra	
0yrs	4
1 - 3yrs	5
4 – 6yrs	2
7 – 9yrs	1
10 – 12yrs	0
13 – 15yrs	0
16 – 18yrs	1
19+ yrs	2
Total Number of Years Teaching Algebra I	
0yrs	0
1 - 3yrs	6
4 – 6yrs	3
7 – 9yrs	1
10 – 12yrs	0
13 – 15yrs	1
16 – 18yrs	1
19+ yrs	3

Table 1 (continued)

Highest Level of Academic Training	
BA Degree	7
BA Degree with 15 hrs or less toward their Masters	2
BA Degree with more than 15 hrs toward their Masters	1
Master's Degree	3
Master's Degree plus additional hours toward Doctorate	1
Doctoral Degree	1

To attempt to determine how familiar participants were with Algebra I, participants were asked if there were any gaps between the present time and the last time they may have taught the course. The majority 73% (n = 11) did not have any gaps in teaching Algebra I. One individual had a one-year gap while two others had a three-year gap. Only one individual responded that they had taught Algebra I six or more years ago.

Using the initial invitation script, (Appendix B) potential participants were contacted using phone or email. Teachers who participated were asked to sign the consent form (Appendix C). Additionally, during the study they were asked to complete a demographic survey (Appendix D). Demographic information from the survey was recorded electronically within 24 hours of receiving it. At that time, the paper version of demographic information was destroyed. The electronic version of their demographic information was then maintained on an electronic, password protected data storage device. Paper copies of the consent forms, as well as the electronic storage device, were kept in a file cabinet in a locked office. The original paper consent forms will be destroyed within one year after the completion of the study. The judgment data collected

from each participant will be kept for five years after the completion of the study before being destroyed.

Instrumentation

Cue profiles used to obtain teachers' judgments were created from existing student information. Specific types of student information were selected based on a review of the extant literature regarding the prediction of math achievement. From this body of literature, five general themes appeared to consistently emerge. These five themes were considered cues for the purpose of the study. Further rationale for selecting the specific number of cues was predicated on the ten or less guideline recommended for SJT statistical analyses (Cooksey, 1996). Four of the cues were demographic in nature and were retrieved from the school district's informational database. Those cues were the following: socioeconomic status (indicated by whether or not the child receives free or reduced lunch) (Ma & Kishor, 1997; Schreiber & Chambers, 2003;), gender (Dowker, 2005; Schreiber & Chambers, 2003;), ethnicity (Penner, Batsche, Knoff a&Nelson, 1993), and self-concept (Schreiber & Chambers). The fifth cue was an indicator of academic performance and consisted of overall academic performance as indicated by grade point average (GPA) (Byrnes & Miller, 2007) taken at the time of the study. Data regarding the self-concept cue was obtained by the district the using an instrument supplied by the researcher to measure this construct. The instrument was called the *Self-Description Questionnaire II* (Marsh, 1992).

The *Self-Description Questionnaire II* (SDQII) was developed at the SELF Research Centre (Bankstown Campus) University of Western Sydney, Australia. It is based on

the theory that self-concept is multidimensional and hierarchical (Marsh, 1990; Rinn, 2006; Shavelson, Hubner & Stanton, 1976). According to Byrne (1996) SDQ II was perhaps one of the most validated instruments for measuring adolescent self-concept. This instrument had eleven subscales for both academic and social issues. Due to the specific focus of this study, only the subscale related to mathematics self-concept was utilized. Each item asked students to reflect on internal perceptions of their own prowess in mathematics and then respond using a 6-point Likert scale. The full instrument had 102 items. There were 10 items related specifically to math self-concept that used for this study. The SDQ II can be used with adolescents between the ages 13-17. Instrument reliability and validity have been supported by additional research (Gilman, Laughlin & Huebner, 1999; Marsh, Ellis, Parada, Richards & Heubeck, 2005; Plucker, Taylor, Callahan & Tomchin, 1997). According to Leach, Henson, Odom and Cagle (2006) each subscale consistently maintained reliabilities ranging from .80s to low .90s. These data were further correlated with external validity criteria (Marsh, et al., 2005).

In order to collect judgments from the cooperating teachers, profiles were needed. Self-concept data were provided regarding every student in the district who was currently taking Algebra I. The researcher was given the actual surveys. Students were only identified by ID number. The researcher was not informed how ID numbers were created or coded. Altogether 1,020 surveys, which represented students in grades 7 to 11, were provided to the researcher. Of those 979 were potentially considered for the study. Surveys unfit for the study were considered so due to illegibility, errors completing the survey or surveys which were not completed. Of the potential surveys remaining, based on the use of five cues and study size parameters which required a minimum of ten

profiles per cue; 60 were randomly chosen from across the five different grade levels (Cooksey, 1996a). Once the 60 were selected, they were matched, by student ID numbers, with a table provided by the district and consisting of the remaining four demographic cues. All five cues, which represented an individual student's profile, were compiled in tabular form to be used as scoring sheet for the Algebra I teachers (Appendix F).

Procedures

Upon completing the consent form teachers were asked to complete a brief, demographic survey (Appendix D). At that time teachers received the instructions for completing the instrument (Appendix F). After reading the instructions the teachers could completethe instrument (Appendix E). Arrangements were made to collect the consent and demographic forms as well as the survey instrument itself. Within twenty-four hours after retrieving participant judgments, score sheets along with demographic surveys were recorded electronically and stored on a password protected data storage device. Original demographic documents were destroyed.

After observing each profile, participants were asked to record their judgment on a score sheet. The participants had four possibilities from which to choose. The choices were as follows: unsatisfactory, limited knowledge, satisfactory and advanced. The nomenclature for the performance levels as well as their brief, verbal and numerical descriptions were obtained directly from the Oklahoma State Department of Education (2006) testing and interpretation literature. Each time the subjects made a choice they were making a judgment regarding that child's future performance on the Oklahoma

Algebra I EOI assessment. Each judgment option represented a specific level of achievement. Both the verbal and numerical descriptions were used in an attempt to account for potential variances in each subject's background knowledge of the exam (Cooksey, 1996a).

Data Preparation and Analysis

After receiving all of the surveys, analyses were conducted in three phases according to Social Judgment Theory (SJT) protocols (Cooksey, 1996a). Procedurally, SJT analyses follow a very straight-forward series of phases. Each phase consisted of a step or series of steps. These steps were a combination of regression and correlation analyses.

Phase I

Phase I of analysis consisted of understanding the ecology. The ecology was the actual situation. It represented the literal cues and decision space subjects were working in. The examination of the ecology was conducted using SPSS software to run a regression analysis. The five cues were simultaneously regressed on the criterion, actual student EOI scores. From this a prediction equation was generated. Based on this equation, predicted EOI scores were computed. Finally, in Phase I, a correlation was conducted to see how the actual and predicted EOI scores compared.

Phase II

Phase II consisted of capturing each teacher's decision policy or strategy. This was accomplished by running individual regression analyses on each teacher's prediction of student EOI scores based upon how they used the supplied cues. From these regressions, each teacher had their own prediction equation. Based on this equation, EOI scores were computed and correlated with the actual EOI scores. This provided a sense of the goodness-of-fit for the prediction equation and overall teacher performance. Next, usefulness indices were calculated, using a formula supplied by the SJT literature, to understand what weight, in the form of a percentage, each cue held in that teacher's decision strategy.

Phase III

Phase III was fundamentally the process of policy or decision strategy comparisons. This phase had two parts. The first part consisted of comparing each teacher's decision strategy in the form of a prediction equation with the prediction equation from the actual context or ecology. The second part of the analysis was accomplished by comparing all teachers' decision strategies or prediction equations with each other.

Comparing Teachers' Policy with the Ecology

This part of Phase III consisted of three correlations. The first was to determine teacher performance or accuracy. It was designed to see how accurate they actually were

in predicting EOI scores. This was a correlation between actual EOI scores from the students with EOI scores predicted by teachers.

The second correlation in this part of Phase III consisted of a correlation between each teacher's EOI scores generated by their individual prediction equations and the EOI scores generated from the ecology's prediction equation. This provided a sense of how well each matched under perfect conditions.

The third correlation in Phase III was designed to compare the residuals from each teacher with the residuals from the ecology or actual context. This allows one to understand indirect or unmodeled influences on the decision model.

Comparing Decision Policies Among Teachers

The part of the Phase III analysis consisted of correlations between each teacher's predicted and residual values with the same set of values from another teacher. These statistics were designed to understand within-group dynamics. Coefficients were examined for any patterns or themes.

CHAPTER IV

FINDINGS

As an idiographic study, the analyses focused on understanding the fundamental elements involved within each teacher's decision-making policy. Additional analyses consisted of correlational comparisons among subjects to look for consistent themes or patterns of intuitive decision-making. Fundamentally, the analyses developed in three phases. The first phase consisted of understanding which cues from the data best predicted the actual or ecological Algebra I EOI scores. This served as a sort of a baseline to understand what actually existed. The second phase consisted of capturing decision policy structures of each teacher. The third phase consisted of two comparisons. One comparison examined the relationship between the teachers' decision policies with the actual ecology. The last analysis consisted of comparisons among the teachers. The purpose of each phase was to produce results that, when taken individually or in combination, would answer the following research questions:

1. Do the teachers' decision-making strategies show evidence of intuitive utilization of cues?
2. What cues or combinations of cues were most salient to the teachers?
3. How statistically accurate were their predictions?
4. Are there any consistencies in the decision-making policies among the teachers?

Phase I

According to Cooksey (1996a) understanding an accurate picture of the actual ecology is vital to conducting SJT research. The ecology, once again, was considered the context in which decisions were made. This phase is critical for establishing ecological validity. Such validity allows the SJT researcher to make accurate comparisons of the teachers' decisions and cue utilizations to the actual context. To do so, actual EOI results were obtained from the school district. Next, a multiple regression analysis was conducted, using SPSS, to determine how the five cues related to the prediction of each student's actual Algebra I EOI score. Originally, there were 60 students used to create the cue profiles, however 1 of the 60 children did not show the day the Algebra I EOI assessment was given. Table 2, revealed the multiple regression analysis on student performance ($n = 59$) was significant [$F(5,53) = 10.880$; $p < .05$]. Specifically, each cue was examined for significance by a review of t-tests. It was determined that GPA was significant ($t = 5.427$; $p < .05$) which accounted for about 51% ($r = .712$) of the variability in student scores.

Table 2

Ecology Regression Analysis

Model	Sum of Sq.	df	Mean Sq.	F	Sig.
Regression	11.504	5	2.301	10.880	.000
Residual	11.208	53	.211		
Total	22.712	58			

Intercorrelations were examined also. Two of the cues (lunch and ethnicity) showed a moderate (-.378) correlation (Shavelson, 1996). Table 3 below shows the correlations between the cues and actual EOI scores as well as intercorrelations with each other.

Table 3

Ecology Cue Correlations

Cues	Actual EOI	GPA	Self-Concept	Gender	Ethnicity	Lunch
Actual EOI	1.000					
GPA	.624	1.000				
Self-Concept	-.258	-.175	1.000			
Gender	.292	.122	-.056	1.000		
Ethnicity	.241	.128	.147	.279	1.000	
Lunch	-.299	-.114	-.036	-.144	-.378	1.000

In addition to GPA, the other four cues were retained for additional analyses. Although four of the cues were not statistically significant, and two of the cues had moderate intercorrelations, all were kept due to theoretical significance of representative design and ecological validity (Cooksey, 1996a; Hammond, 1996). Therefore, the Phase I analysis produced a prediction equation generated here (Algebra 1 EOI = 3.2 + 1.086(GPA) + (-.280)(Self-Concept) + .196(Gender) + .045(Ethnicity) + (-.212)(Lunch). An additional correlation was generated to determine how well the actual EOI scores compared to those generated from the prediction equation. The results were found to be significant ($r = .711$; $p < .01$).

Phase II

Having once defined the actual, optimal ecology, policy capturing could begin. Policy capturing was useful to help answer research question one which stated, "Do the teachers' decision-making strategies show evidence of intuitive cue utilization?" The use of the Lens Model was designed to cause the teachers to think holistically and intuitively (Cooksey, 1996a; Hammond, 1996). Policy capturing was a critical step used to examine the evidence or substance of how such intuitive decisions were made. A policy, in Social Judgment Theory (SJT), was the way to conceptually to describe one's decision-making approach or strategy. In order to answer the first research question, and because SJT methodology was an idiographic approach, individual regression analyses were conducted in order to define each teacher's cue utilization. After running the analysis, t-tests were examined to determine which cues were most statistically significant by the teachers. Table 4 provides the specifics on this statistic. Table 4 also has a statistic on it referred to as a "usefulness index" (Cooksey, 1996a, p. 169). Such indices provide theoretical significance for each cue and help to further answer research question one as well as question two which stated, "What cues or combinations of cues were most salient to the teachers?" Both policy capturing and the usefulness index shed light on how the individual utilized the cue regardless of its statistical significance. The usefulness indices are in the form of percentage. SJT methodology allows the researcher to compute cue utilizations by use of the following formula (Figure 1).

Figure 1

Usefulness Index Formula

$$sr^2 = \frac{t_i^2}{m-k-1}\left(1 - R_{Y_s}^2\right)$$

In the above formula, sr^2 is the proportion of variance in judgment scores that is explained by cue *i* over and above what is explained by the remaining cues. The symbol, t_i^2 is that cue's t-test ratio. In the denominator, m, is the number of profiles, while k is the number of cues and the $R_{Y_s}^2$ is taken from the full model equation. SJT methodology used this procedure to reflect the relative cue importance based on inherent drawbacks of standardized regression weights (Cooksey, 1996a). The use of sr^2 maintained its unique variance utility because it reflected that cue's individual contribution relative to the total R_2 (Cooksey, 1996a).

Table 4

Statistically Significant and Theoretically Significant Cue Utilizations

Teacher	F Values	Significant Cue Utilizations				
1	F[(5,53) = 6.775] *	(GPA t = 4.612; r = .564) (Lunch t = -1.960; r = -.293)				
	Usefulness Indices (%)	Gender = .2	Ethnicity = .42	Lunch = 14.26	GPA = 79.23	Self-Concept = 5.89
2	F[(5,53) = 26.017] *	(GPA t = 10.584; r = .836)				
	Usefulness Indices (%)	Gender = .66	Ethnicity = .09	Lunch = .15	GPA = 98.43	Self-Concept = .66
3	F[(5,53) = 29.253] *	(GPA t = 11.287; r = .849)				
	Usefulness Indices (%)	Gender = .03	Ethnicity = 1.56	Lunch = .03	GPA = 98.1	Self-Concept = .27

Table 4 (continued)

Teacher	F Values	Significant Cue Utilizations				
4	F[(5,53) = 18.652]*	(GPA t = 8.627; r = .781)				
	Usefulness Indices (%)	Gender = .27	Ethnicity = .51	Lunch = .33	GPA = 95.12	Self-Concept = 3.77
5	F[(5,53) = 24.437]*	(GPA t = 10.344; r = . 825)				
	Usefulness Indices (%)	Gender = 0	Ethnicity = .17	Lunch = .73	GPA = 97.07	Self-Concept = 2.03
6	F[(5,53) = 9.960]*	(GPA t = 6.566; r = . 686)				
	Usefulness Indices (%)	Gender = .75	Ethnicity = 0	Lunch = 1.51	GPA = 96.55	Self-Concept = 1.19
7	F[(5,53) = 52.415]*	(GPA t = 15.536; r = .911)				
	Usefulness Indices (%)	Gender = .28	Ethnicity = .05	Lunch = .01	GPA = 99.66	Self-Concept = .02
8	F[(5,53) = 58.985]*	(GPA t = 16.763; r = .919)				
	Usefulness Indices (%)	Gender = 0	Ethnicity = .01	Lunch = .36	GPA = 99.53	Self-Concept = .1
9	F[(5,53) = 10.336]*	(GPA t = 6.253; r = .678)				
	Usefulness Indices (%)	Gender = .07	Ethnicity = 1.04	Lunch = .48	GPA = 91.80	Self-Concept = 6.61
11	F[(5,53) = 13.195]*	(GPA t = 7.217; r = .692) (Lunch t = -2.782; r = -.335)				
	Usefulness Indices (%)	Gender = .64	Ethnicity = .2	Lunch = 12.72	GPA = 85.72	Self-Concept = .73

Table 4 (continued)

Teacher	F Values	Significant Cue Utilizations				
15	F[(5,53) = 3.924] *	(GPA t = 3.819; r = .493)				
	Usefulness Indices (%)	Gender = 1.18	Ethnicity = 0	Usefulness Indices (%)	Gender = 1.18	Self-Concept = 1.19
17	F[(5,53) = 37.259]*	(GPA t = 12.684; r = .873)				
	Usefulness Indices (%)	Gender = .02	Ethnicity = .05	Usefulness Indices (%)	Gender = .02	Self-Concept = .02
18	F[(5,53) = 9.136]*	(GPA t = 5.481; r = .621)				
	Usefulness Indices (%)	Gender = 2.92	Ethnicity = .01	Usefulness Indices (%)	Gender = 2.92	Self-Concept = .1
	Cue Utilization Averages	Gender .51%	Ethnicity .78%	Lunch 4.08%	GPA 92.64%	Self-Concept 1.99%

* Regression was significant at the 0.05 level.

As noted in Table 3 above, most of the individuals showed statistical significance in the cue utilization of GPA. However, three individuals showed statistical significance for utilization of the lunch cue. Table 5 below provides demographic detail of these individuals.

Table 5

Statistical Significance of Lunch Cue Utilization

	Subject		
Demographics	1	11	14
GPA Cue Utilization	79.23%	85.72%	80.98%

Table 5 (continued)

	Subject		
Demographics	1	11	14
Lunch Cue Utilization	14.26%	12.72%	16.95%
Gender	Female	Male	Female
Age	26-33	42-49	50+
Ethnicity	Caucasian	Caucasian	Caucasian
Total Years Taught	4-6 years	4-6 years	19+ years
Years Taught Pre-Algebra	4-6 years	1-3 years	7-9 years
Years Taught Algebra I	1-3 years	4-6 years	19+ years
Last time taught Algebra I	3 years ago	0 years ago (no gaps)	0 years ago (no gaps)
Highest Academic Level Achieved	BA	BA +15 hrs or less toward Masters	Master's
Certification Type	Traditional	Traditional	Traditional

Lastly, a "goodness-of-fit" (Cooksey, 1996b, p.154) analysis was conducted to compare actual, teacher EOI values and those derived from the ecology prediction equation generated from the ecological regression (Table 6). This statistic, which is the R_s for each teacher's captured judgment policy, provided additional depth and perspective

for cue utilization. This was because it allowed the researcher to understand what departure, if any, there was between each teacher's prediction model and the actual teacher predictions.

Table 6

Goodness-of-Fit Correlations

Teacher	Pearson Correlation	Teacher	Pearson Correlation
1	.625*	9	.703*
2	.843*	11	.745*
3	.835*	12	.796*
4	.795*	14	.705*
5	.835*	15	.520*
6	.695*	17	.882*
7	.912*	18	.680*
8	.921*		

*Correlation was significant at the 0.01 level (2-tailed).

Phase III

Perhaps the most significant contribution of the Lens Model to SJT method was its ability to provide the researcher with a mechanism to compare two interacting systems. The way this was done was to compare separate, but parallel, indices between the teacher and the ecology and between the teachers themselves. Phase III is therefore, fundamentally, policy comparing. In this particular study, two separate sets of

comparisons or correlations were conducted. The first set of correlations was designed to compare the teacher and the actual context or ecology. These statistics helped answer the third research question. The second set of correlations was to understand the relationships between teachers' decision polices. The statistic produced there helped to answer the fourth research question.

Comparison of Teachers and Ecology

The three statistics generated in the analyses comparing the teacher with the ecology answered the third research question which was, "How statistically accurate were their informal predictions?" The first of the correlations between the teacher and the ecology was referred to as "achievement" (Cooksey, 1996a, p. 210). Specifically, this correlation represented a comparison of the teachers' actual decision predictions of student EOI with the actual EOI scores attained by the student. Achievement was therefore an assessment of teacher performance. Performance, in the context of SJT, was actually a representation of accuracy or correspondence. Table 7 shows the correlated relationships. As a group, the average correlation was .556.

Table 7

Achievement Indices

Teacher	Correlation of Actual Judgment and Actual EOI	Teacher	Correlation of Actual Judgment and Actual EOI
1	.503*	9	.517*
2	.578*	11	.467*

Table 7 (continued)

Teacher	Correlation of Actual Judgment and Actual EOI	Teacher	Correlation of Actual Judgment and Actual EOI
3	.605*	12	.566*
4	.567*	14	.413*
5	.570*	15	.335*
6	.454*	17	.594*
7	.655*	18	.465*
8	.519*		

*Correlation was significant at the 0.01 level (2-tailed).

Modeled Knowledge. The second statistic used to explain teacher intuitive accuracy was a correlation designed to denote "linear" or "modeled knowledge" (Cooksey, 1996a, p. 210). Statistically, this correlation represented the extent to which the predicted EOI values and the teachers' predicted decisions would have related if both models were perfect. To better understand this concept, the "matching index" was calculated (Cooksey, 1996a, p. 210). Conceptually, this correlation reflected the degree of similarity between the prediction equation from the ecology and the prediction equations from each teacher in terms of weight and function. Table 8 provides the results of this analysis. The average among the correlations for the matching indices was .919 among the teachers.

Table 8

Matching Indices

Teacher	Correlation of Teacher and Ecology Prediction Equations	Teacher	Correlation of Teacher and Ecology Prediction Equations
1	.958*	9	.949*
2	.930*	11	.881*
3	.950*	12	.932*
4	.918*	14	.947*
5	.877*	15	.969*
6	.901*	17	.899*
7	.892*	18	.924*
8	.851*		

*Correlation was significant at the 0.01 level (2-tailed).

Unmodeled Knowledge. The third correlation analysis designed to understand teachers' intuitive achievement and performance was done in order to account for unmodeled or "configural" knowledge (Cooksey, 1996a, p. 211). This analysis was conducted to ascertain the possible differences between the prediction equations from the ecology and each teacher. Unmodeled knowledge was situated within the residuals of both prediction models (Cooksey). Statistically, this index represented the correlation between both sets of residuals and depicted the degree to which each teacher's decision policy accurately utilized unmodeled aspects of the cues or cue transformations to make a

decision. The results of this analysis can be found in Table 9. The average for the correlations of unmodeled knowledge was .052 for the group.

Table 9

Unmodeled Knowledge Indices

Teacher	Correlation of Teacher and Ecology Prediction Equation Residuals	Teacher	Correlation of Teacher and Ecology Prediction Equation Residuals
1	.140*	9	.084*
2	.054*	11	.001*
3	.139*	12	.091*
4	.071*	14	-.124*
5	.128*	15	-.039*
6	.015*	17	.089*
7	.265*	18	.033*
8	-.137*		

*No correlation reached significance.

Comparisons Among the Teachers

The final analysis consisted of correlations between teachers. This series of analyses answered the fourth research question which stated, “Are there any consistencies in the decision-making policies among the teachers?” This analysis was conducted to understand the interpersonal dynamics of cue utilizations among this group of teachers. Conceptually, it signified the amount of agreement or similarity between the decision-

making models among the teachers. Although the emphasis in SJT methodology is primarily idiographic, individual analyses can produce themes and patterns which may have implication at the group level. Table 10 shows these correlations.

Table 10

Agreement Correlations Between Teacher's Decision Policies

Teacher															
	1	2	3	4	5	6	7	8	9	11	12	14	15	17	18
1	-														
2	.725*	-													
3	.699*	.842*	-												
4	.739*	.834*	.869*	-											
5	.660*	.768*	.863*	.831*	-										
6	.640*	.737*	.693*	.654*	.628*	-									
7	.602*	.836*	.842*	.832*	.775*	.688*	-								
8	.499*	.744*	.769*	.726*	.787*	.607*	.811*	-							
9	.648*	.721*	.799*	.816*	.769*	.601*	.770*	.609*	-						
11	.711*	.751*	.797*	.704*	.675*	.679*	.754*	.653*	.720*	-					
12	.770*	.855*	.853*	.866*	.783*	.688*	.837*	.717*	.807*	.790*	-				
14	.741*	.727*	.746*	.720*	.671*	.706*	.713*	.589*	.805*	.830*	.758*	-			
15	.762*	.635*	.664*	.656*	.591*	.623*	.606*	.455*	.758*	.784*	.721*	.799*	-		
17	.660*	.819*	.844*	.811*	.880*	.742*	.839*	.789*	.754*	.720*	.843*	.690*	.671*	-	
18	.785*	.769*	.756*	.778*	.682*	.681*	.755*	.537*	.775*	.809*	.800*	.852*	.805*	.729*	-

*Correlation was significant at the 0.01 level (2-tailed).

Agreement was composed of several components. Essentially, this construct, consisted of the modeled and unmodeled portions of each teacher's decision policies. The first element calculated in this study was the modeled aspect. This coefficient was a statistic which established the degree of linear decision pattern similarities between teachers. These coefficients can be found in Table 11.

Table 11

*Pattern Similarities Among Teacher's Modeled Decision Policies**

Teacher															
	1	2	3	4	5	6	7	8	9	11	12	14	15	17	18
1	-														
2	.932	-													
3	.931	.992	-												
4	.951	.994	.987	-											
5	.893	.986	.982	.985	-										
6	.954	.984	.986	.984	.977	-									
7	.906	.995	.988	.981	.987	.982	-								
8	.875	.984	.985	.966	.986	.973	.995	-							
9	.957	.985	.979	.998	.978	.980	.968	.951	-						
11	.951	.926	.934	.914	.878	.953	.926	.910	.904	-					
12	.940	.993	.994	.983	.966	.979	.987	.977	.973	.952	-				
14	.992	.925	.930	.934	.873	.946	.903	.875	.936	.974	.947	-			
15	.973	.972	.966	.969	.924	.962	.955	.930	.963	.965	.985	.980	-		
17	.919	.992	.991	.993	.997	.986	.989	.985	.988	.902	.979	.904	.945	-	
18	.980	.931	.951	.950	.907	.957	.907	.892	.958	.936	.944	.976	.955	.934	-

*Note. All correlations were significant at the 0.01 level (2-tailed).

The last element decomposed from the aforementioned agreement construct was the amount of correlation between each teacher's unmodeled policy similarities. This statistic revealed the degree of correspondence between each teacher's similar, but still unmodeled knowledge of policy formation. Statistically, these values were the result of correlations between each teacher's standardized residuals. These coefficients can be found in Table 12.

Table 12

*Pattern Similarities Among Teacher's Unmodeled Decision Policies**

Teacher															
	1	2	3	4	5	6	7	8	9	11	12	14	15	17	18
1															
2	.558**														
3	.500**	.451**													
4	.565**	.507**	.624**												
5	.453**	.248	.565**	.528**											
6	.401**	.414**	.284*	.247	.152										
7	.268*	.323*	.331*	.475**	.101	.218									
8	-.013	-.093	-.039	.067	.136	-.061	-.156								
9	.411**	.358**	.570**	.597**	.497**	.238	.511**	-.022							
11	.516**	.473**	.583**	.401**	.353**	.386**	.456**	.112	.519**						
12	.640**	.612**	.561**	.663**	.422**	.336**	.486**	.004	.609**	.558**					
14	.550**	.465**	.503**	.455**	.402**	.474**	.455**	.077	.676**	.673**	.529**				
15	.668**	.455**	.531**	.494**	.405**	.448**	.439**	.029	.669**	.719**	.607**	.726**			
17	.417**	.321*	.391**	.393**	.560**	.403**	.224	-.059	.421**	.406**	.549**	.384**	.590**		
18	.644**	.596**	.533**	.594**	.412**	.432**	.638**	-.074	.607**	.684**	.650**	.739**	.746**	.489**	

**Note. Correlations were significant at the .01 level (2-tailed).

*Note. Correlations were significant at the .05 level (2-tailed).

CHAPTER V

CONCLUSIONS AND IMPLICATIONS

The purpose of this research study was to determine the effectiveness of math teachers' predictions regarding a student's future academic achievement. In order to understand how these predictions were made this study demonstrated the use of Social Judgment Theory (SJT) as a possible means for explaining this process. Methods were employed to collect teacher judgments based on specific cues used as predictors of success. Successfully performing the act of teaching was fundamentally the act of making decisions (Behre, Astor & Meyer, 2001; Ferry & Ross-Gordon, 1998). A teacher's ability to make decisions in ill-defined and shifting contexts, such as the typical classroom, could not be accomplished by purely rational, algorithmic means (Humphreys & Hyland, 2002). What was needed was a tool for teachers equal to the task of making decisions when sifting through the multifarious layers constituting today's classrooms. One option proposed, by many familiar with education and the various choices among decision-making systems, was intuition (Burke & Sadler-Smith, 2006; Cloninger, 2006; Humphreys & Hyland, 2002). It seemed that in ill-defined environments such as nursing, business management and education individuals tended to actually acknowledge the use of intuition (Miller, 1993; Rew, 2000).

Statement of the Problem

Realizing that teachers made decisions within a confluence of factors embedded within the context of the classroom, further encouraged the use of intuition as a potentially superior decision-making mechanism (Schreiber & Chambers, 2003). In this study, what was needed was a way to understand how math teachers used extant cues to make those decisions. Developing an understanding of the intuitive decision-making constructs teachers used was important given that classroom characteristics tended to minimize the teacher's ability to make deeply reflective decisions typically considered more rational and analytic (March, 1976). Social Judgment Theory (SJT) appeared to be a possible framework to better analyze and operationalize sophisticated decision-making systems such as intuition (Heald, 1991; Cooksey, 1996; Hammond, 1996).

Review of the Methodology

According to Cooksey (1996a), researchers who used SJT sought to understand how individuals made their decisions based on how those they observed available, proximal cues. These proximal cues became the lens through which the individual viewed some distal criterion of interest and then internalized or centralized that information in order to make their intuitive decision. In this study, the criterion of interest for the subjects was predicting student performance on the Algebra I EOI assessment. Mathematics education literature cited several observable cues considered to be relevant predictors of student performance. In particular, the literature noted gender (Dowker, 2005; Geary, 1996), ethnicity (Penner, Batsche, Knoff & Nelson, 1993), Grade Point Average (GPA) (Schreiber & Chambers, 2003), self-concept (Schreiber & Chambers,

2003), and socioeconomic status (Ma & Kishor, 1997). The cues used in an SJT study effectively became the lens. The concept of a lens formed the central component within SJT called the "lens theory" (Heald, 1991, p. 347). This lens then became the portal through which the subject would interface with the ecological decision space. This study then used a series of regression and correlation analyses to understand the dynamics of intuitive utilization of cues and decision-making processes. Once again, SJT is primarily an idiographic versus a nomothetic methodology. The following discussion will show individuals of interest with some application and implications made to teaching in general or to this particular group.

Ultimately, problem conceptualization and exploration of one's context were essentially addressed simultaneously in this study. The problem was inextricably linked to the context or as it is referred to in SJT as "ecology" (Cooksey, 1996b, p. 149). Accurately understanding the ecology of a problem was significant in SJT research (Hammond, 1996). An accurate depiction of one's ecology is called "representative design" (Cooksey, 1996b, p. 143). This was the central tenet of SJT research (Hammond). The concern was for an appropriate extraction of cues or elements, within a given ecology. These cues were later to be used to create profiles from which judgments will take place. How judges utilized the same cues to make judgment across several different cases or profiles was determined by means of multiple regression analysis. The weights placed upon each cue were then correlated with the actual, ecological weights determined in advance of the study. Additionally, each teacher made intuitive predictions. The accuracy of these predictions, known as "achievement," as well as similarities of

predictions among the teachers, known as “agreement” became of focus of SJT research (Cooksey, 1996b, p. 142).

Summary and Discussion of Findings

Phase I

This phase of the research was used primarily to establish and understand the ecology or actual context. In this case the ecology consisted of analyzing which cues best predicted the students’ actual EOI performance. In SJT research it was vital to understand the context in which the subjects performed. This particular regression revealed that GPA ($r = .712$) was the only cue to significantly predict Algebra I EOI performance. This meant that GPA alone accounted for approximately 51% of the variance in EOI scores. This confirmed research which showed that high school GPA was reasonably to strong predictor of general student success (Geiser & Santelices, 2007; Bonfadini, 2005).

Phase II.

This phase of analysis was necessary to capture each teacher’s decision-making structure or policy. Policy capturing was useful to help answer research question one which stated, “Do the teachers’ decision-making strategies show evidence of intuitive utilization of cue?” The analyses in this phase did reveal possible instances of intuitive thinking. This may have been demonstrated by the fact that although teachers tended to favor the use of GPA, they also used additional cues to some degree. It seems that, within the various profiles, certain cues were more salient than others. Although GPA was the

most used, math self-concept scores and lunch or SES cues ranked as second and third most used cues respectively. In particular, the lunch/SES cue was utilized to a statistically significant degree by 3 teachers. There may, however be another way of looking at this result. Because the GPA cue was such a clear choice among the teachers it may have actually demonstrated some the use of some internal formula and therefore may have not been intuitive at all. Variances in cue selections may have revealed how teachers navigated intuitively through the "zone of ambiguity" (Heald, 1991, p. 349). Variances in cue selections may reveal an attempt by teachers to understand causal linkages (Heald). Humphreys and Hyland (2002) referred the search for such linkages as "improvisations" (p. 10). They believe that cue selection variances are possibly the sign that intuition is being used because it is the representation of a departure from rules and algorithms. Again, the results of this study were unclear because GPA was chosen by individuals as little as 79% and as much as 99% of the time as their cue of choice.

Policy capturing provided the evidence for how teachers made their decisions. From that analysis cue usefulness indices were calculated. This statistic allows one to understand the internalized decision policy of each teacher by showing the weight or utilization of each cue. This statistic also helped answer question two which stated, "What cues or combinations of cues were most salient to the teachers?" It seems from the analysis that teachers utilized multiple cues to some degree. GPA was the most important cue. Utilization indices for GPA among the teachers ranged from 79.23% to 99.66% with an average 92.64% across all 15 subjects. This finding appears to indicate that not all cues were useful. Even though GPA was most used most often, both lunch and self-concept cues were also utilized. Teachers tended to use same 3 out of 5 possible cues.

The narrowing down of cues may possibly confirm another finding from the literature of an attempt by individuals to intuitively reduce uncertainty in the decision-making process. The use of intuition enables individuals to reduce most, but not all uncertainty. The remaining uncertainty was labeled by Hammond (1996) as "irreducible uncertainty" (p. 14). This may show an attempt on behalf of the teacher to narrow the emotional gap between the known and unknown (Easen & Wilcockson, 1996). Within the literature the general consensus is that such reductionistic efforts may indicate the use of intuition (Sabers, Cushing & Berliner, 1991; Dreyfus & Dreyfus, 1986). Such reductionistic strategies would also have explained how these types of teachers make such fast, accurate and low-effort decisions within the classroom (Burke & Sadler-Smith, 2006). The idea here is that fewer, more meaningful cues, simply take less time to process while providing emotional satisfaction and confirmation within the individual (Simon and Kadane (1975).

Phase III.

The final phase of this study involved comparing teacher decision policies. In this particular study, two separate sets of comparisons were conducted. One comparison was between each teacher and the ecology while the other comparison was between each teacher. The first set of comparisons helped answer the third research question. The second set of comparisons produced a statistic which helped to answer the fourth research question.

Comparing Teachers to the Ecology

The three statistics generated in the analyses comparing the teacher with the ecology answered the third research question which was, "How statistically accurate were their informal predictions?" Based on SJT methodology, accuracy or "achievement" is result of 3 multiplicative components; teacher knowledge, task predictability and cognitive control (Cooksey, 1996a, p. 210).

Achievement. Understanding the accuracy of one's decision-making is a significant goal of the policy comparing phase of SJT methodology. As noted in the previous chapter, all correlations were statistically significant. The practical significance of this however, is tempered by the fact that, as a group, the teachers were correct only about 31% ($r = .556$) of the time. Such a low degree of accuracy matched the criticism leveled by Van Der Vleuten, Dolmans and Scherpbier (2000). They stated that intuitive judgment is seldom correct especially when compared against evidence-driven decisions. Perhaps a compromise regarding intuitive usage was best articulated by King and Appleton (1997). They posited a compelling, balanced, argument when they stated that their studies showed that intuition occurs as a response to knowledge and was a trigger for deeper reflection and analysis. In their approach, intuition and knowledge or evidence worked in tandem to make a decision. Therefore, the lower achievement indices may show evidence of an unclear understanding of the theoretical or practical import of some of the cues or combinations of cues

Matching Index. SJT methodology also allows the researcher to gain insight into how teachers use their knowledge. The "matching index" theoretically represents such linear knowledge (Cooksey, 1996a, p. 210). This concept reveals how each teacher uses

their knowledge of task ecology. The matching index is a measure of how a teacher uses their linear knowledge to the point where they are right or nearly right, in the degree of correspondence, between the ecology's cue weights and their own policy cue weights. This study found that teachers could potentially, predict scores approximately 72% to 94% of the time. This statistic revealed the true potential of teachers' decision-making by denoting the level of accuracy. Cooksey, Freebody and Davidson (1986) stated that the way to improve teacher performance was through "cognitive feedback" (p. 61). Methods of feedback such as this inform, clarify and thus, improve teachers' understanding.

Predictability. This variable helped shed more light on the ecology because it provided the optimal "predictability" of the context given the same set of cues (Cooksey, 1996b, p. 162). In this study it was determined that this correlation was significant ($r = .711$; $p < .01$). This statistic revealed that about 51% of the variances in EOI scores were explained by the supplied cues. This meant that there may be other cues which were omitted, but could be used to better predict this phenomenon. It could have also meant that such systematic influences on the criterion of measure resulted from instrumentation errors or testing biases (Cooksey, 1996b, p. 162).

Cognitive Control. The idea of "cognitive control" conceptually represents the teacher's control over how their decision policy was executed from profile to profile. (Cooksey, 1996b, p. 160). The term, "control," does not necessarily mean the same things as "consistency" or other similar terms. Consistency would be appropriate if the same profile were randomly spread several times throughout the total number of profiles (Cooksey, 1996a). An individual would be considered "consistent" if they judged the same way each time that same profile appeared. This statistic was referred to as

"goodness-of-fit" (Cooksey, 1996b, p.154). This study found that some teachers used the same decision policy as little as 39% of the time while others used theirs approximately 86% of the time.

Unmodeled Knowledge. This form of knowledge, also known as "configural", represents similarities between the undefined or unknown relationships within the teacher and also the ecology (Cooksey, 1996a, p. 211). In this study the configural knowledge among the teachers and the ecology was low. According to Cooksey (1996b), if these coefficients are low, precision in interpretation is more difficult. Such low coefficients may have denoted a lack of knowledge of the impact of unmodeled cues or combinations of cues or other unknown modifications. Such interactions may cloud cue utility. These differences could have occurred if cues were modified and utilized in some similar, yet predictive way in regards to the EOI score. Low correlations mean that there was no similarity in the way teachers combined or modified cues. This may have been a reflection of a lack of general, empirical knowledge of the cues. This type of difference was referred to as a "cue transformation" (Cooksey, 1996b, p. 163). Such transformations occurred when subjects used cues in ways that redefined their meaning, relevance or intent.

Comparing Teachers

The statistics generated for this final analysis were computed in order to help answer the fourth research question, "Are there any consistencies in the decision-making policies among the teachers?" In understanding how intuition functions, this question is important to address in this study. The construct of intuition of may be better operationalized by examining the decision policies of individuals who were completing

the exact same task. The statistical analyses here consisted of correlations among the teachers. The simplicity and flexibility of SJT methodology came in part from the ability to use essentially the same Lens Model Equation (LME). What follows is a discussion of the three components from the equation most relevant to this part of the analysis; policy agreement, and the similarities between modeled and unmodeled portions of teacher's decision policies.

Agreement. Conceptually, agreement meant what its name implied. It is the degree of similarity between actual student EOI predictions from the teachers. In this study, the average for the group was 55% (r = .741), therefore just over half of a teacher's decision policy or strategy was similar with another teacher. A correlation of particular interest was between Teacher 8 and Teacher 15 which represented the lowest degree of similarity.

Teacher 8 taught Pre-Algebra for 1-3 years and Algebra I for 13-15 years with a total of between 13-15 years of total teacher experience. Meanwhile, Teacher 15 taught both Pre-Algebra and Algebra I for 19 or more years. Therefore, Teacher 15 had more years of teaching experience. When it came to professional training and credentials, even though both teachers shared the fact they were traditionally certified, Teacher 8 seemed to be superior. This individual had their Master's plus additional hours toward their Doctorate and was NBCT certified. Teacher 8 achieved the "highly qualified" status and had earned a Master's degree with no additional hours. The last compelling statistic to note in this comparison was each teacher's achievement or accuracy. Teacher 15 had an achievement score of .335 while Teacher 8 had a score of .519. In other words, Teacher 15 was correct approximately 12% of the time. Teacher 8 however, was accurate 27% of

the time. This is not necessarily a significant difference, but merely shows a possible relationship between one's training or education and their performance.

It appeared from this study that the comparison of Teacher 8 and 15 may have revealed that the quality of one's training may be superior to years of experience. This finding is congruent with Burke and Sadler-Smith's (2006) emphasis. Their article stated that receiving the right kind of education enhances or even develops intuitive thinking. This may also reveal the qualitative aspects of Teacher 8's experiences. As Hogarth (2001) noted certain environments are not accurate in the type, amount and quality of feedback they provide. For example, some environments may confuse causal with correlated cause-effect relationships. Therefore, one could conceivably spend months or years in their careers working within contexts filled with false-positives and false-negatives.

Another interesting comparison was between the two teachers (5 and 17) whose policies matched nearly 77% of the time. They both had essentially identical years of teaching experience in Pre-Algebra and Algebra I. Teacher 17 however, had a total of 16-18 years of total teaching experience while Teacher 5 had 1-3 years of experience. In regards to education and credentials, both were traditionally certified, but Teacher 17 had over 15 hours of Master's level coursework completed. Achievement coefficients were also fairly similar as well (Teacher 5 = .570; Teacher 17 = .594). Based on those indices, Teacher 5 was accurate approximately 33% of the time while Teacher 17 was accurate approximately 35% of the time. This finding could have revealed some relationship between years of total teaching experience and years of teaching experience within a particular content area or grade level. Even though Teacher 17 had several more years of

teaching experience; both had the same experience in Pre-Algebra and Algebra I. This similarity in Algebra-specific experience may have been the key. Such a finding may denote something specific about content-associated training regimes or experiences specific to particular subject matter. It may have possibly revealed some linkage to teachers having self-concepts related to their perceptions of their own judgments associated with different content areas (Shavelson & Marsh, 1985).

Similarities Among Modeled Portions of Decision Policies. This represents the overall, modeled, linear knowledge similarities between each combination of teacher decision policies. The degree of cue utilization similarities were quite high ranging from 77% ($r = .875$) to 99% ($r = .998$) among the teachers. This statistic reveals that teachers use cues or combinations of cues in a very similar ways to ultimately construct their decision policies.

Similarities Among Unmodeled Portions of Decision Policies. Unmodeled knowledge represents differences in cue usage. This type of difference was referred to as a "cue transformation" (Cooksey, 1996b, p. 163). Such transformations may have been a reflection a lack of general, empirical knowledge of the cues. The reason this component was considered "unmodeled" was because it was unclear how subjects used cues and in what ways that redefined their meaning or intent. This study produced both significant and insignificant coefficients. The significant indices ranged from .268 to .746 with an average correlation of .455 for the group.

High coefficients represented two teachers who had very similar, yet unmodeled aspects of cue usage and decision policies. Low coefficients here represented a situation where one or both teachers had substantive, unmodeled portions of their decision policies. This study showed that an average of approximately 21% of each teacher's unmodeled cue usage matched another teacher. Therefore, almost 80% of their unmodeled knowledge was unique to that teacher. This meant that each teacher had a very personalized approach to interpreting and/or combining the various cues.

Conclusions

The activities and analyses conducted in this study were designed to better understand how teachers make decisions within an educational context. An examination of intuition and the methodology associated with Social Judgment Theory (SJT) was selected as a means to explain the decision-making process. The specific decision being made was of math teachers' predictions of student performance on a future assessment. This study had three phases of analysis in order to answer the four research questions. This study was unable to determine with complete certainty that teachers made their predictive decisions through purely intuitive means. This study did find that teachers did not seem to use all possible cues, their use of decision-making was accurate and there was a significant degree of consistency among the modeled portions of the teachers' decision policies. This section contains a brief synopsis and summary.

The first finding shows evidence of how teachers' decision making strategies utilized available cues. These findings appear to show that teachers may have used

intuitive decision-making to some degree to determine student success. However, there may be another way to view this finding.

It seems from the data that teachers clearly preferred the use of the GPA cue. Although there were minor variances in the cues teachers chose, the fact that there were variances and that they narrowed down the number of cues demonstrates they may have used intuitive means to shape their decision strategies. However, because GPA was such a consistent choice it is important to note that this may be an indication that they may have used more rational, analytic means.

Cue utilization indices were necessary to answer the second research question which asked what cues were most significant to the teachers. In particular, teachers seemed to choose GPA, lunch (i.e. student's SES status as defined by being a recipient of free or reduced lunch) and the student's self-concept scores. Though the combination of cues as well the degree of their utilization may have been different for the teachers, they appeared to examine the particulars of each profile carefully. While doing so it seemed that, based on the slight variances of cue utilizations, some cues became more salient than others. This shows teachers were not necessarily following a context-free formula, but instead intuitively examined each profile holistically and simultaneously.

The third finding revealed the degree of accuracy among the teacher. Based on this study, it was discovered that, although statistically significant, teachers only achieved an average accuracy rating of about 31% when estimating EOI performance. One important issue to remember though was that they were confined to cues they were provided. Additionally, although they did choose GPA most of the time within their decisions, that cue was found to be able to explain only about 51% of variance in EOI

scores. Clearly there were other potential cues which may have served as better predictors.

The last finding in this study discovered that teachers shared approximately 55% similarity in their predictions of student performance. This is important because the degree of similarity is indicative of how similar or dissimilar teachers' ideological, perceptual or experiential backgrounds are to each other. This shows the elusive and individualistic nature of their thinking. The unique background each teacher possesses is believe to be combined with the ability to notice patterns or similarities. This is further compounded by their knowledge of extant cues may help explain such unique and personalized decision policies.

Limitations to Conclusions

There did not seem to be any obvious pattern when teacher demographics were compared with cue utilizations or teacher achievement and agreement. There could be a couple of possible explanations for this. One possible reason for this was that the teachers were not timed when completing the instrument. Hammond (1996) believed time constraints served as a catalyst for shifting decision processes along the continuum. For example, he found that if the subject had little time they tended to drift into more intuitive modes. When they had more time they tended to be analytic. This time constraint was certainly a factor in the actual, naturalistic decision-making environment of the classroom Orasanu and Connolly (1993). Due to certain logistical constraints inherent within this study, time constraints could not necessarily be imposed.

Another possibility for explaining patterns in teacher-cue utilizations in this study, was the lack of feedback they were provided. The specific feedback for shifting modes of thinking was the subject's success or lack thereof. Hammond referred to this type of feedback as, "cognitive feedback" (1996, p. 270). Cognitive behaviors that produced successful results tended to be reinforced. If efforts were unsuccessful, the individual's cognitive activities moved toward the opposite end of the continuum. Feedback served as a mechanism to fine-tune one's pattern-matching process, thus effectively editing their decision policy. Intuition researchers may better understand intuitive processes, by more fully understanding the qualitative aspects of both the teacher training of novice teachers and the experiences of more seasoned veterans (Burke & Sadler-Smith, 2006 Cioffi, 2002;). Good, pre-service teacher training and experiences from "kind" environments (Hogarth, 2001, p. 88-89) could provide individuals with the necessary, accurate, patterns to make decisions. Hammond (1996) emphasized that pattern utilization may be best used in certain situations. The key to pattern usage depends upon the quality of the pattern. Specifically, he felt that good patterns were those that offer recognizable coherence to either the untrained or more seasoned individuals. Randi (2004) modifies the external emphasis of environments and stresses internal processes such as teachers becoming self-regulated. She stated that the quality of external environments and experiences teachers could learn from, could be ameliorated if they are not purposeful, intentionality, and self-regulated. This study provided no such feedback and instead relied upon the inherent experiences and skills teachers possessed. Based on the results of this study, it appeared teachers may have generated some sort of internal decision policy and simply executed it on each profile.

Another type of feedback was that of emotion. Again, this study simply used a paper survey with student characteristics, in the form of cues, listed on it. Teachers may have needed the valuable feedback obtained from the emotional feelings generated through classroom interactions Cloninger (2006). Incorporating such feelings may have helped improve accuracy.

An additional limitation may have been the use of GPA as a cue. It seemed apparent from the results of this study that teachers focused on this cue. Such overwhelming focus may have skewed the ability to measure possible intuitive thinking. GPA is a cue that is commonly known and easy to interpret. It may have been chosen so frequently because it is easy to understand and familiar to most teachers. Therefore, it is unclear whether teachers chose GPA intuitively or as a result of some internally derived formula.

One last limitation to this study was its size. Although it may the protocols for the SJT methodology, additional analyses, generalizations and conclusions were difficult to make. Larger groups and sub-groups could allow more powerful and sophisticated analyses. For example multivariate or ANOVA analyses could be conducted to determine the specific differences between teachers' decision policies both within and between groups.

Implications for Theory

This study helps reveal certain aspects of the novice/expert continuum so frequently discussed in intuitive circles; specifically, the idea of how intuition, expertise and cue utilization relate to each other. In particular, the interpretation of cue utilizations and its relationship to expertise needs to be carefully investigated. Cue usage tells the

researcher what was used, but not why or how. Does the use of a singular cue show the application of context-free rule following typically associated with novices? Or is such behavior indicative of an expert who has reduced superfluous cues down to the most salient? To the contrary, does the use of several cues equate to the uninformed guessing of novices or does this demonstrate the skill of an expert who has learned to take several factors into account and that no child can be defined by a single characteristic?

Secondly, this study may have shed light on the role of experiences and training. In either context feedback occurs. Years of experience did not guarantee superior performance nor does one's academic preparation. The quality, timing, nature and amount of feedback are important elements to consider. The research conducted here revealed that sometimes years of experience and good training may be evenly matched. Also, implication may have been made regarding possible content-specific differences among feedback systems. Years of general teaching experience may not equate to experience within a give subject matter. Is there a difference?

Thirdly, the role of emotion as an element of intuitive decision-making must be further explored. The design of this study had teachers merely reading a narrow set of student characteristics and the asked them to make a prediction. What additional intuitive insight could be gained by physically interacting with the child and knowing what they are like? Would the feeling a teacher gains by actual interaction enhance their accuracy? Emotion is inherent within the idea of having a "gut-feeling."

Implications for Research

The results found here revealed what teachers thought, for example regarding cue utilizations. However, it seemed clear that a follow-up of some sort would have been beneficial. Such information may have provided increased insight in the form of teacher rationale regarding cue usage and EOI performance prediction. Proponents of SJT methodology have used talk-aloud protocols to document the thinking process while the individual completed the instrument. Obtaining an individual's rationale could also be accomplished by a carefully prepared survey or follow-up interview. For future studies, researchers could perhaps, pre-screen teachers to ascertain their understanding of cues that will be used in the study. Otherwise Cooksey's (1996b) recommendation was to keep looking for better cues.

Implications for Practice

This study helped show the potential power of understanding the elements of intuitive decision-making. Universities involved in teacher preparation and school districts alike may improve teacher performance by understanding how teachers make decisions. Social Judgment Theory (SJT) and methodology help articulate the elements of the decision process; making the covert overt. It is important to not only possess knowledge, skills and dispositions, but teachers must be able to operationalize those principles in the form of good decision-making. SJT allows one to understand the components of the intuitive decision-making process. Intuition enables its user to quickly prioritize and reduce the number of possible options. This effectively makes them more efficient and allows the teacher to move quickly and precisely within the classroom

context. Because of the idiographic aspects of the method, individuals as well as groups of teachers could be helped. For example, an entire grade level or department could receive specific evaluation. Certain cues, based upon the host culture's beliefs or ideologies, could be essentially field-tested in order to understand how they are utilized by their constituents. Such insight may potentially reveal strengths or weaknesses and therefore provide a platform for professional development or program improvement.

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APPENDICES

Appendix A

Human Subject's Research

Research approval from OSU's Institutional Review Board for the Protection of

Research approval form is included on the following page.

Oklahoma State University Institutional Review Board

Date:	Thursday, May 08, 2008
IRB Application No	ED0881
Proposal Title:	Math Teachers' Intuitions About Student Success in Algebra
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 5/7/2009

Principal Investigator(s):

Jerry Eshleman
8230 S. Oswego
Tulsa, OK 74137

Diane Montgomery
424 Willard
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Shelia Kennison, Chair
Institutional Review Board

Appendix B

Invitation Script

Invitation script is included on the following page.

Participant Invitation Script

Dear Educator,

You are invited to participate in a study designed to understand how teachers make decisions. This will require between 20-30 minutes of your time. You will view profiles containing various characteristics of students currently enrolled in Algebra 1 classes. After reviewing each profile you will make an estimate regarding how well you feel they'll perform on the Algebra 1 end-of-instruction (OCCT) assessment for Oklahoma. You will also be asked to complete a short set of demographic questions.

Complete confidentiality will be maintained and your name will not be on any study information or linked in any way. Deciding to participate or not will in no way effect your standing with your school district.

Please contact Jerry Eshleman at 918-520-5108 or jleshleman@gmail.com as soon as you can schedule a time to be part of this exciting study. Thank you for your consideration.

Sincerely,

Jerry Eshleman

Appendix C

Consent Form

Consent Form is included on the following page.

Okla. State Univ. IRB
Approved 5/8/08
Expires 5/7/09
IRB # EQ0881

Participant Informed Consent

Project Title: Math Teachers' Intuitions About Student Success in Algebra

Investigator: Jerry Eshleman, MA Ed., fulfilling Ph D. dissertation requirements in Educational Psychology at Oklahoma State University

Purpose: The purpose of this research study is to investigate how teacher use indicators to signal student future success in math.

Procedures: You will be provided with profiles of sixty children who were enrolled in Algebra 1 during the 2007-2008 school year. You will briefly review each profile and estimate their performance on the Algebra 1 end-of-instruction assessment. Reviewing all profiles and recording your estimate will take about 20-30 minutes. Additionally, a short demographic survey will be provided to determine general description about you.

Risks of Participation: There are no known risks associated with this study greater than those ordinarily encountered in daily life.

Benefits: Results from this research may be helpful in preparing math teachers to better understand their decision-making strategies. This information will better inform the preparation of pre-service teachers as well as designing professional development activities for in-service teachers.

Confidentiality: Your name will not be linked to any research data nor demographic information collected from you. This consent form will be stored separately from any information collected. Demographic information will be used to assist analyzing the results. Your responses are strictly confidential and there is no way, without names, that any information can be revealed as belonging to you. Only group information will be reported in this study.

All study information will be securely stored in a file cabinet in the researcher's locked office. The paper copies will be destroyed one year after the completion of the study. Only the researcher will have access to the information stored on an electronic, password-protected storage device. Paper copies will be kept for 1 year from the completion. At that time they will be destroyed. Electronic copies will be kept for 5 years after the completion of the study. At that time they will destroyed

The OSU-IRB has the authority to inspect consent records and data files to assure compliance with approved procedures.

Contacts: Contact the researcher if you have questions or concerns about this research project: Jerry Eshleman, PO Box 700114, Tulsa, OK 74170, (918) 495-6053, jerry.eshleman@okstate.edu or his advisor, Diane Montgomery, Ph.D., Professor of Educational Psychology, 424 Willard Hall, Stillwater, OK 74078, (405) 744-9441, diane.montgomery@okstate.edu

For information on participants' rights contact Dr. Shelia Kennison, Ph.D., IRB Chair, 219 Cordell North, Oklahoma State University Stillwater, OK 74078, (405) 744-1676. IRB compliance email: irb@okstate.edu

Participant Rights: Participation in this research activity is entirely voluntary. You are free to decline to participate and may stop or withdraw at any time. There is no penalty for withdrawing your participation from the research.

Signatures: I have read and fully understand the consent form. I sign it freely and voluntarily. A copy of this form has been given to me.

_____ _____
Signature of Participant Date

I certify that I have personally explained this document before requesting that the participant sign it.

_____ _____
Signature of Researcher Date

Appendix D

Demographic Form

Demographic Form is included on the following page.

Participant Demographic Survey

Name: _____

Directions: Please circle only one answer for each question.

1. I am:
   a. Male
   b. Female

2. I am:
   a. 18-25
   b. 26-33
   c. 34-41
   d. 42-49
   e. 50+

3. I am:
   a. African-American
   b. Caucasian
   c. Hispanic
   d. Native American
   e. Asian American
   f. other

4. At the conclusion of this school year, I will have taught for a total of: ***(this is the sum total of all your years of teaching experience regardless of the grade level or content)***
   a. 1-3 yrs
   b. 4-6 yrs
   c. 7-9 yrs
   d. 10-12 yrs
   e. 13-15 yrs
   f. 16-18 yrs
   g. 19+ yrs.

5. At the conclusion of this school year, I will have taught **PRE-ALGEBRA** for a total of:
   a. 0 yrs
   b. 1-3 yrs
   c. 4-6 yrs
   d. 7-9 yrs
   e. 10-12 yrs
   f. 13-15 yrs
   g. 16-18 yrs
   h. 19+ yrs

6. At the conclusion of this school year, I will have taught **ALGEBRA 1** for a total of:
   a. 0 yrs
   b. 1-3 yrs
   c. 4-6 yrs
   d. 7-9 yrs
   e. 10-12 yrs
   f. 13-15 yrs
   g. 16-18 yrs
   h. 19+ yrs

7. (***NOTE: This question is in reference to how consistently you have taught Algebra I from year to year***.)

   Prior to this year, how long ago did you last teach Algebra I?

   a. 0 years (there have not been any gaps)
   b. 1 year ago
   c. 2 years ago
   d. 3 years ago
   e. 4 years ago
   f. 5 years ago
   g. 6 or more years ago

8. Highest level of academic training:
   a. I have a Bachelor's degree only
   b. I have a Bachelor's degree with 15 hours or less of course work at the Masters level
   c. I have a Bachelor's degree with more than 15 hours of Masters level coursework
   d. I have earned a Master's degree
   e. I have a Masters with coursework at the Doctoral level
   f. I have a Doctorate

9. Certification:
   a. Traditional
   b. Alternatively certified
   c. NBCT
   d. If you currently have any additional certificates and/or endorsements, please list them in the space below:

Appendix E

Teacher Prediction Instrument

Item is included on the following page.

Performance Prediction Sheet

Please estimate each student's future performance on the Oklahoma Algebra 1 end-of-instruction (OCCT) assessment.

STEP #1: Please examine each student's **Profile Information**. (located on the left-half of the table below.)

STEP #2: Based on your review, record what level of performance (located on right-half of the table below) you feel they will achieve on the Algebra 1 end-of-instruction (OCCT) assessment. (**Please choose by circling only one performance level below.**)

Circle the letter "**A**" if you feel they will perform at the **Advanced** Level (732 or higher)
Circle the letter "**S**" if you feel they will perform at the **Satisfactory** Level (700 to 731)
Circle the letter "**L**" if you feel they will perform at the **Limited Knowledge** Level (612 to 699)
Circle the letter "**U**" if you feel they will perform at the **Unsatisfactory** Level (611 or lower)

Profile Information						Predicted Performance Level (Please circle only ONE answer.)			
Student #	Ethnicity	Gender	Cum GPA	Free/Reduced Lunch	Math Self-Concept Score	Unsatisfactory (611 or lower)	Limited Knowledge (612-699)	Satisfactory (700-731)	Advanced (732 or higher)
1	HISPANIC	F	2.7778	FREE	31	U	L	S	A
2	BLACK	F	2.9231	FREE	39	U	L	S	A
3	WHITE	M	2.9231		42	U	L	S	A
4	WHITE	M	2.3077		18	U	L	S	A
5	WHITE	M	2.3077		33	U	L	S	A
6	HISPANIC	M	1.3077	REDUCED	34	U	L	S	A
7	WHITE	F	2.7692		35	U	L	S	A
8	WHITE	F	3.3846	REDUCED	38	U	L	S	A
9	WHITE	M	2.7692		42	U	L	S	A
10	WHITE	F	2.7692		35	U	L	S	A
11	INDIAN	M	1.2308		28	U	L	S	A

12	WHITE	F	2.3077		13	U	L	S	A
13	WHITE	M	2.7692		41	U	L	S	A
14	WHITE	M	2.9231		32	U	L	S	A
15	ASIAN	M	2.7692		47	U	L	S	A
16	INDIAN	M	1.5844	FREE	33	U	L	S	A
17	WHITE	F	2.0000		26	U	L	S	A
18	INDIAN	M	2.1429		23	U	L	S	A
19	WHITE	F	1.9535	FREE	39	U	L	S	A
20	WHITE	M	2.3243		16	U	L	S	A
21	INDIAN	M	1.9487	REDUCED	31	U	L	S	A
Profile Information						**Predicted Performance Level (Please circle only ONE answer.)**			
Student #	**Ethnicity**	**Gender**	**Cum GPA**	**Free/Reduced Lunch**	**Math Self-Concept Score**	**Unsatisfactory (611 or lower)**	**Limited Knowledge (612-699)**	**Satisfactory (700-731)**	**Advanced (732 or higher)**
22	WHITE	F	1.1385		15	U	L	S	A
23	WHITE	M	2.4103	FREE	46	U	L	S	A
24	WHITE	F	2.2078		47	U	L	S	A
25	WHITE	F	2.7442		47	U	L	S	A
26	WHITE	M	2.2198		43	U	L	S	A
27	WHITE	M	1.9808		37	U	L	S	A
28	WHITE	F	2.6557		20	U	L	S	A
29	WHITE	M	1.7209		50	U	L	S	A
30	BLACK	F	2.7213	FREE	13	U	L	S	A
31	BLACK	M	2.0000	FREE	36	U	L	S	A
32	WHITE	F	4.0000		57	U	L	S	A
33	WHITE	F	3.8889		53	U	L	S	A
34	WHITE	F	4.0000		43	U	L	S	A
35	WHITE	F	3.8333		53	U	L	S	A
36	INDIAN	M	4.0000		46	U	L	S	A
37	INDIAN	M	4.0000		58	U	L	S	A
38	WHITE	F	4.0000		43	U	L	S	A

39	WHITE	M	3.6667		53	U	L	S	A
40	INDIAN	M	2.8333		14	U	L	S	A
41	WHITE	M	3.8333		56	U	L	S	A
42	WHITE	F	3.6667		47	U	L	S	A
43	BLACK	M	2.2778	FREE	43	U	L	S	A
44	WHITE	M	3.8333		43	U	L	S	A
45	WHITE	M	3.1111		34	U	L	S	A
46	ASIAN	F	3.7778		47	U	L	S	A
47	WHITE	M	3.6111		30	U	L	S	A
48	WHITE	F	2.5000		20	U	L	S	A
49	WHITE	F	3.6111		33	U	L	S	A
50	WHITE	F	3.5556		35	U	L	S	A
51	ASIAN	F	4.0000		54	U	L	S	A
52	WHITE	M	3.2222		50	U	L	S	A
53	WHITE	M	0.8333		28	U	L	S	A
54	WHITE	M	3.6667		48	U	L	S	A
55	WHITE	M	3.0000		23	U	L	S	A
56	BLACK	M	2.8333	FREE	41	U	L	S	A
Profile Information						**Predicted Performance Level (Please circle only ONE answer.)**			
Student #	**Ethnicity**	**Gender**	**Cum GPA**	**Free/Reduced Lunch**	**Math Self-Concept Score**	**Unsatisfactory (611 or lower)**	**Limited Knowledge (612-699)**	**Satisfactory (700-731)**	**Advanced (732 or higher)**
57	WHITE	M	3.3889	REDUCED	33	U	L	S	A
58	WHITE	F	3.6667		50	U	L	S	A
59	ASIAN	M	3.3333		50	U	L	S	A
60	INDIAN	M	4.0000		37	U	L	S	A

Appendix F

Instructions for Completing the Teacher Prediction Instrument

Document is included on the following page.

Instructions for Predicting Student Performance

OVERVIEW:

You will be looking at student profiles. Each profile contains **actual** student information in the following areas:

- Ethnicity
- Gender
- Overall GPA (recorded at the time they would have taken the Algebra 1 end-of-instruction assessment)
- If they receive a free or reduced lunch
- Math self-concept score
    - 10-26 = a low self image/esteem in the area of math (This child perceives that they struggle with math.)
    - 27-43 = an average self image/esteem in the area of math (This child perceives that they are average and do ok in math.)
    - 44-60 = a high self image/esteem in the area of math (This child perceives that they do well in math.)

YOUR TASK:

1. Review each student's profile
2. Imagine that they have been a student in your class, but the profile information is all you knew about them.
3. Quickly review each profile and then, please estimate how each child will do on the Oklahoma Algebra 1 end-of-instruction assessment (OCCT) by circling the most appropriate performance level on the performance prediction sheet provided in this packet.
4. Your answers will be in the form of performance level descriptors actually used for the end-of-instruction assessment. Both the written and numeric end-of-instruction Algebra I description is included below to assist you:

Advanced (732 or higher): Students typically demonstrate a thorough understanding of the knowledge and skills expected of all students at the End-of-Instruction in Algebra I, which includes objectives in the areas of number sense and algebraic operations; relations and functions; and data analysis and statistics. In addition to demonstrating a broad and in-depth understanding and application of all skills at the Satisfactory level, students typically use a wide range of strategies to solve real-world, nonroutine problems; regularly use various types of reasoning effectively; consistently connect one area or idea of mathematics to another; and communicate mathematical ideas clearly through a variety of representations.
Satisfactory (700 to 731): Students typically demonstrate a general understanding of the mathematics knowledge, skills, and processes expected of all students at the End-of-Instruction in Algebra I, as follows: translate word phrases and sentences into expressions and equations; use the laws of exponents to evaluate expressions with integer exponents; distinguish between linear and nonlinear data; identify and evaluate a function; use slope to differentiate between parallel, perpendicular, horizontal, or vertical lines; develop the equation of a line and graph linear relationships; match simple equations or inequalities to a graph, table, or situation; use formulas to solve two-step problems; make valid predictions and/or arguments based on collected data; and use a line-of-best-fit model to represent collected data.
Limited Knowledge (612 to 699): Students demonstrate a partial understanding of the mathematics knowledge, skills, and processes expected of all students at the End-of-Instruction in Algebra I. Students are typically inconsistent in applying the general knowledge and mathematical process skills necessary to solve problems effectively and reason mathematically.
Unsatisfactory (611 or lower): Students do not demonstrate even a Limited Knowledge level of the skills expected of all students at the End-of-Instruction in Algebra I. These students typically should be given comprehensive mathematics instruction.

If you have questions, please contact:

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VITA

Jerry Lee Eshleman

Candidate for the Degree of

Doctor of Philosophy

Dissertation: MATH TEACHERS' INTUITIONS ABOUT STUDENT SUCCESS IN ALGEBRA

Major Field: Educational Psychology

Biographical:

Personal Data: Born in Akron, Ohio on July 15, 1972. The son of Rebecca and Jerry Eshleman Sr.

Education: Graduated from Tuslaw High School, Massillon, OH in May 1990; received Bachelor of Arts in Christian School Administration from Central Bible College – Springfield, MO in May 1996; received Master of Arts degree in Education – Christian School Administration Emphasis from Oral Roberts University – Tulsa, OK in May 2001; Completed requirements for Doctor of Philosophy degree with a major in Educational Psychology at Oklahoma State University, School of Applied Health and Educational Psychology – Stillwater, OK in May 2009.

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ADVISOR'S APPROVAL: Dr. Diane Montgomery

Name: Jerry Lee Eshleman Date of Degree: May, 2009

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: MATH TEACHERS' INTUITIONS ABOUT STUDENT SUCCESS IN ALGEBRA

Pages in Study: 128 Candidate for the Degree of Doctor of Philosophy

Major Field: Educational Psychology

Scope and Method of Study: The purpose of this research study was to determine the effectiveness of math teachers' judgments regarding a student's future achievement. Judgments were based on external observations or cues used as predictors of success. This study used Social Judgment Theory (SJT) to demonstrate a possible method for better understanding how teachers make decisions. For this study, the teachers made judgments in the form of predictions on the student's future performance in the Algebra I end-of-instruction assessment as used by the state of Oklahoma. The predictors or cues extracted from math education literature as relevant to student performance are gender, ethnicity, Grade Point Average (GPA), self-concept and socioeconomic status.

Findings and Conclusions: This study supports the proposition that teachers may have used intuitive decision-making to make predictions of student performance. This was evidenced by the reduced number of cues they relied upon. The findings revealed, as anticipated, out of the 5 possible cues, teachers used GPA as their primary means to base their prediction decision. However, because GPA was so heavily relied upon to make their decisions, it is unclear if they used intuitive or analytical means of decision-making. Although the reduction in the number of cues utilized may reveal intuitive thinking, another possible way of looking at this was that teachers relied upon a formula. This formula appears to emphasize the superiority of GPA as a predictor. Regardless of the means in which GPA was ultimately chosen, teachers attained statistically significant levels of accuracy. In addition, when compared to each other, teachers' decision strategies had a high degree of similarity. This study found following: teachers did not seem to use or need all possible cues provided, their use of decision-making was accurate and there was a significant degree of consistency among the teachers' decision policies or strategies.

ADVISOR'S APPROVAL: Dr. Diane Montgomery