A STRUCTURAL AND CORRELATIONAL ANALYSIS OF TWO COMMON MEASURES OF PERSONAL EPISTEMOLOGY

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Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
December 2010

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MEASURES OF PERSONAL

EPISTEMOLOGY

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ACKNOWLEDGEMENTS

While writing my acknowledgements I was completely caught off guard as to what an emotional process this would be. I have been part of the REMS program for nine years, and have been influenced and encouraged by a group of faculty who mean more to me than I could ever fully express. Dr. Perry, I started your Program Evaluation course when my first child was five weeks old. I didn't see how I would be able to leave my daughter, commute to Stillwater for class, study, and go back to work. But there was something about your passion for evaluation and strong presence that inspired me. I think of you almost daily while working as an evaluator here in Charlotte. I wouldn't be in this position without you. Dr. Miller, I am exceedingly indebted to you for introducing ANOVA to me in such a remarkable way. Your class was one of my absolute favorites throughout my master's and doctorate. I was thrilled to also have the opportunity to take non-parametric methods with you. That was an incredibly challenging time in my life. Throughout that three week course I opened a business, became a single parent (my husband had already moved to NC), traveled back and forth to Charlotte to find a new home, packed our house, and moved in with my mother…and your course was the little bit of comfort that kept me sane. Thank you so much for encouraging me and being so understanding during that time. Dr. Montgomery, I cannot thank you enough for introducing me to Q-Methodology. Because of this, I have presented at conferences and mentored colleagues at work as they look to introduce Q-Method in their evaluations.

The Q has become one of my favorite statistical methods. Thank you for offering OSU students the unique opportunity to study this technique with you.

Dr. Fuqua, you deserve a paragraph all your own. You have been my inspiration for close to ten years. I bounded into your 5953 class not at all interested in research or statistics – I was a gerontology major. I can still recall how immediately captivated I was that first day of class. The way you explained them, the concepts were absolutely fascinating to me. I *loved* that class. By the end of the semester I knew my path in life would change; research and statistics had become my passion. I remember how after I defended my thesis you gave me a "thumbs-up" when I mentioned I was interested in the doctoral program. That meant the world to me. Although you may not fully realize it, you've been an incredible inspiration and encouragement for me throughout my graduate years. You have seen me through the deaths of my father, beloved Grandma June, Papa, Aunt Pody, Aunt Marge, and my mother-in-law. You've also seen me through the birth of my two children, the opening of my own business, and my move across the country. And throughout it all, you reminded me to breathe…and to take care of myself. You were somehow able to see things in me that I couldn't…and you gave me the confidence to keep going. I am so blessed to have known you and to have you as my advisor, and mentor.

To my mother: I don't even really know where to begin, as so much goes without saying. Thank you for being such a strong, beautiful woman who inspires me every day to be a better person. Thank you for showing me I could be anything in the world I wanted to be. Thank you for loving and never giving up on me. Thank you for crying with me during the hard times, and laughing with me during the good. Thank you for

being such a wonderful role model of what a wife, mother, sister, daughter, and friend should be.

To my family: I wouldn't be here without your love, support, and understanding. Clint, you have been more patient than any husband has the right to be. Throughout my graduate years you have stood by me, never once complaining about being a "single dad" or never seeing your wife. You always encouraged me to follow my dream, and I couldn't have done this without you. Thank you for being such an incredible husband and father. Hannah, one of my favorite memories was when I was leaving the house to go to class one night. I gave you hugs and told you I was going to school. As I was walking out the door you ran after me. "Here, Mommy", you said, as you handed me a picture you had just crayoned. "For your cubby"! Thank you for being such an amazing daughter, and such a beautiful person. Kaden, you're too young to remember me studying and going to class, but thank you for being there for me. Whenever I was stressed or overwhelmed you always saw me through with sweet smiles and cuddles. You have always helped me remember what is important.

Finally, I would like to dedicate my dissertation to my father, the late Robert F. Bost. I made it, Dad…you always thought I could. I love you, and guess what? I didn't fall down…

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CHAPTER I

INTRODUCTION

The study of knowledge, commonly known in educational psychology and philosophy as epistemology, has long been considered a significant foundation within the academy with roots tracing to 400 B.C. in the work of Plato (Buehl & Alexander, 2001). Epistemology in a general sense may be defined as the study of knowledge and justified belief (Steup, 2005). With respect to knowledge, epistemology is concerned with examining its conditions, source, structure, and limits. With respect to justified belief, epistemology aims to uncover whether justification is internal or external, and what makes beliefs justified. Though traditionally epistemology has been explored primarily within a global framework, there has been a recent emergence in research devoted to the concept of personal epistemology. In close relation to epistemology, personal epistemology may be characterized as the beliefs individuals hold about knowledge: what it is, where it comes from, how it is attained, and how it is justified (Schommer, 1994). Hofer (2004) offers a similar definition of "a field that examines what individuals believe about how knowing occurs, what counts as knowledge and where it resides, and how knowledge is constructed and evaluated" (p.1).

Though scholarly interest in personal epistemology has escalated in recent years, its literature base is remarkably limited. Perry's (1970) work with undergraduate students is generally regarded as the catalyst which sparked scholarly interest in the topic. Since then, several researchers have followed suit with attempts to unearth the true nature

of personal epistemology and its underlying dimensions. However, despite a 40-year history, studies of personal epistemology are comparatively sparse, with conflicting results as to the underlying dimensions of personal epistemology (Buehl & Alexander, 2001; Hofer, 2001; Knight & Mattick, 2006; Lonka & Lindblom-Ylänne, 1996). Scholars are also at odds as to the theoretical framework of personal epistemology (developmental vs. independent beliefs, theories or systems) and what constitutes epistemological beliefs, versus beliefs of learning or intelligence (Buehl & Alexander, 2001; Hofer, 2001; Hofer & Pintrich, 1997; Schommer-Aikins & Duell, 2001). Moreover, scholars are in disagreement as to whether epistemological beliefs vary among academic disciplines, with some positing that students from more quantitative and scientific disciplines hold different personal epistemological beliefs than those from fields more oriented toward arts and humanities (Buehl & Alexander, 2001; Hofer & Pintrich, 1997). Given such conflicting views and limited inquiry, it is not unreasonable to speculate the true nature of personal epistemology is largely unknown. Although the intent of the current study was to analyze the psychometric qualities of current quantitative measurements designed to assess personal epistemological beliefs, it is first necessary to consider the theoretical framework of personal epistemology.

Theoretical Framework

The theoretical structure of epistemological beliefs has endured significant debate among researchers. When Perry began his ground-breaking work in the area of student perspective, thus leading the way to the study of personal epistemological beliefs, he constructed his findings from a developmental perspective. Several scholars followed in suit, including Kuhn (1991), Baxter Magolda (1992), and King and Kitchener (1994).

Although several studies have supported the notion that students transcend various epistemological stages or dimensions sequentially as age and education level increase (King & Kitchener, 1994; Perry, 1970), some researchers find this structure of traditional stage theory (one stage serving as a foundation for the next with transmission a distinctly linear process) too limiting for the multifaceted and dynamic issue of personal epistemology. Schommer (1990) in particular has proposed a more fluid model of beliefs which function independently rather than hierarchically in a relatively predictable manner. In 2004 Schommer revised her framework to embrace what she termed an "imbedded systemic model and coordinated research approach" which incorporates an even wider scope of dynamic cognitive aspects. In lieu of a developmental stage approach, the current study will function within the framework of Schommer's imbedded systemic model. This model will be explained in detail in the review of literature.

Despite an apparent lack of agreement among scholars as to the fundamental structure and nature of personal epistemology, this construct, even within its various interpretations, has proved an important consideration in student learning. Several studies have determined students' underlying personal beliefs significantly influence their academic motivation and behaviors. With respect to motivation, Dweck (1988) determined students' personal beliefs strongly affect their academic efforts and performance. Other research has found epistemological beliefs influence students' behavior and processing of cognitive information (Buehl & Alexander, 2001; Hofer & Pintrich, 1997). A recent study which examined the relationship between epistemological beliefs and use of learning strategy in the academic setting found sophisticated epistemic beliefs positively correlate with use of advanced strategy

techniques (Dahl, Bals, & Turi, 2005). Understanding students' beliefs about knowledge can provide valuable insight into their ways of knowing and learning. However, without a universally agreed-upon definition of personal epistemological beliefs, or psychometrically-sound instruments with which to measures them, results of such inquiries should be viewed tentatively.

Scholars have conducted exploratory factor analyses on available quantitative measurements designed to assess personal epistemological beliefs, primarily examining the Schommer Epistemological Questionnaire (SEQ) (Schommer et al, 1992) and the Schraw Epistemic belief inventory (EBI) (Schraw, Bendixen & Dunkle, 2002). The intent has been to empirically determine the number and nature of dimensions contributing to personal epistemological beliefs. However, the psychometric properties of these instruments are marginal at best, and replicable factor structures have not consistently emerged in published studies. Reliability estimates of the scales range from .10 to .71 (Chan & Elliott, 2002; Clarebout, Elen, Luyten & Bamps, 2001; Qian & Alvermann, 1995; Schommer, 1990, 1993a, 1998; Schommer et al., 1992), and factor analytic techniques have yielded two to five factors within each instrument, with the majority of SEQ studies utilizing Schommer's 12 item parcels in lieu of the 63 individual items (Chan & Elliott, 2002; Clarebout et al, 2001; Schommer, 1990, 1993a, 1998; Schommer et al., 1992). Studies of both instruments have also relied exclusively on orthogonal rotation of emergent factors, which does not allow examination of potential correlations among factors. Only one published exception may be noted, the 2002 study conducted by Chan and Elliott who rotated Schommer's 12 item parcels both orthogonally and obliquely. As they found the results to be similar, the orthogonal results

were utilized for ease of interpretation. To date, there are no published inquiries examining individual scale items obliquely. An aim of the current inquiry was to examine the factor structure of individual items through an oblique solution.

Though many claim the underlying dimensions of epistemological beliefs are independent constructs uncorrelated with one another, some scholars have questioned the feasibility of such a notion, asserting that theoretically, factors should be correlated (Clarebout et al., 2001; Cole et al., 2000; Lodewijks, Vermetten & Schellings, 1999). Although the multidimensional approach to personal epistemology is by far the most accepted perspective among scholars, the true nature of the construct may be unclear as factor analytic rotations are typically orthogonal. A recent study that examined correlations within a lesser utilized instrument, the Beliefs about Learning Questionnaire (BLQ) (Jehng, Johnson & Anderson, 1993), found moderate to high correlations among the epistemological dimensions, thereby lending support to the concept of interrelated constructs. Cole, Goetz, and Willson (2000) reported correlations as high as .59 (rigid learning and certain knowledge). However, more studies examining the independence of dimensions are clearly warranted.

A recent newcomer to quantitative instruments designed to assess personal epistemological beliefs is the Epistemological Questionnaire Epistemic belief inventory (EQEBI) (Abad, Ordonez, & Romero, 2009), which integrates items from both the SEQ and EBI. Initial studies conducted by the authors concluded the 27-item instrument taps into four of the five original dimensions of personal epistemological belief (quick learning, certain knowledge, simple knowledge, and innate ability), with reliabilities ranging from .59 (certain knowledge) to .82 (quick learning). Although initial results may

be worth consideration, there is an obvious need for subsequent studies to confirm the viability of the EQEBI as an effective quantitative measurement.

Statement of the Problem

Rather than adding clarity to the matter, the study of personal epistemology has primarily generated conflicting findings and even more questions to the definition of the construct itself. Though attempts have been made to quantify the nature of personal epistemological beliefs, namely through the SEQ and EBI, the poor psychometric properties of these instruments lead one to question whether it is the instruments or the construct itself that is in need of further refinement. To that end, there is a blatant need to scrutinize the internal structure of these scales to determine the true nature of the construct of interest. To date, there are no published attempts to determine if a hierarchical factor structure exists between the SEQ and EBI, or to rotate individual SEQ individual items obliquely. Therefore, the current study seeks to examine the factor structures of the SEQ and EBI to investigate the presence of higher order factors; and to build upon previous research by empirically examining the relationship between scale scores and theoretically related constructs.

Research Questions

To fully examine the factor structures of the SEQ and EBI, and to explore the relationship between personal epistemological beliefs and peripheral constructs, the following questions will be addressed in the current study:

1. What is the internal structure of the Schommer Epistemological Questionnaire?
2. What is the internal structure of the Epistemic belief inventory ?
3. Does a hierarchical factor structure exist across the two measures?

4. What is the nature of the relationship between second order factors and motivation, use of strategy, and implicit theories of intelligence?

Significance of the Study

The influence of students' beliefs on their behavior in the academic setting has empirically been established. Multiple studies have examined students' epistemological beliefs and their links to motivation, use of strategy, persistence and academic performance (Braten & Strømso , 2005; Dahl, Bals & Turi, 2005; Dweck & Leggett, 1988; Kardash & Howell, 2000; Schommer, 1992). But, before the concept of personal epistemology can be explored more effectively its dimensions must be examined more closely to identify what is truly being measured by current instruments. A better understanding of epistemological beliefs may bring greater lucidity to this important field as researchers continue to strive to bridge the gap between seemingly disparate schemas, thereby resulting in a more constant, identifiable paradigm for further exploration.

Beyond theoretical implications, a better understanding of personal epistemology may prove beneficial in the applied academic environment as well. Students' beliefs affect their academic performance. A thorough understanding of the true nature of epistemological beliefs may impart educators with the knowledge to encourage meaningful learning or adapt our instructional systems to correspond with students' needs. However, perhaps most importantly, a thorough understanding of personal epistemology may allow educators to empower the student to engage in his or her own creative and critical thinking, thus creating a more informed citizenry.

CHAPTER II

REVIEW OF LITERATURE

Traditionally, scholars have examined three main dimensions within the framework of epistemology: the nature, source, and limits of human knowledge (Muis, Benedixen & Haerle, 2006). Within these dimensions, scholars have also identified multiple types of human knowledge, such as propositional, empirical, and procedural. Though scholars of personal epistemology have not been concerned with the types of human knowledge; indeed, until recently such types have not been referenced in the literature (Schommer-Aikins & Easter, 2006), the dimensionality of the construct, particularly with regard to personal epistemology, has become quite controversial. While quantitative studies have produced inconsistent results as to the number and nature of dimensions, most scholars of personal epistemology believe the construct is multidimensional in nature, with several inherent dimensions or stages in which individuals can move about (Hofer & Pintrich, 1997; Schommer, 1990; Schommer, 1993a & 1993b). However, while some consider these dimensions within the framework of traditional stage theory (Baxter Magolda, 2004; King & Kitchener, 1983), positing that as individuals mature they transcend through each stage sequentially; others regard them as fluid components along a continuum or frequency distribution in which an individual may move to and fro, or within multiple areas simultaneously (Schommer, 1990, 2002; Schommer-Aikins, 2004). Researchers have disagreed upon the exact number of

dimensions comprising personal epistemology, and empirical studies have proven inconclusive on the matter. Though opinions conflict, many scholars concur at a minimum personal epistemology incorporates the organization/structure of knowledge, and certainty of knowledge (Buehl & Alexander, 2001; Hofer & Pintrich, 1997; King & Kitchener 1994; Schommer, 1990; Schommer, 1993a & 1993b; Schommer-Aikins, 2004). In order for the reader to fully appreciate the debate among scholars today it is necessary to briefly examine the origins of personal epistemology research. Therefore, the review of literature will begin with developmental perspectives, followed by multidimensional and other perspectives. The review will conclude with current outcomes and concerns in personal epistemology research.

Theories of Personal Epistemology

The following section offers a concise overview of several of the most prominent or historically significant theories of personal epistemology. The section is not intended to be an exhaustive account of personal epistemology perspectives, but rather a succinct but effective background to provide the reader greater insight into the phenomenon of interest.

Developmental Theorists

Most scholars credit the foundation of personal epistemology to William Perry who extensively studied undergraduate students at Harvard in the late 1960s. Though his work served as a springboard for further research, Perry never actually intended to pioneer the study of personal epistemology. Rather, his intent was to qualitatively study undergraduate students to determine their overall developmental and cognitive transitions from freshman to senior years (Perry, 1970, Schommer, 1994; Schraw, 2001).

Perry's interview questions to students were primarily general in nature: "what stood out to you the past year"? Throughout his collection of responses a recurrent theme emerged. However, rather than exhibiting an evolution of personality as expected, students demonstrated a progression of cognitive transitions, in a fairly uniform way. As students sequenced from freshman to senior years their sophistication of beliefs, particularly with regard to knowledge, increased accordingly. Freshmen students began their college careers with what Perry termed a "dualistic" or dichotomous view of knowledge; Meaning, all knowledge is considered either right or wrong, with little regard to context. However, as students gained academic and overall life experience throughout successive years, their views of knowledge evolved to a more sophisticated, or "relativistic" stage. By senior year the majority of students held a multiplistic, evaluative stance on knowledge, considering each perceived piece of knowledge as contextual in nature. He concluded college students transcend through nine positions of epistemological beliefs throughout their academic tenure which subconsciously pose conflict within the individual. Specifically, as students cognitively adopt new beliefs they encounter dissension with currently held beliefs. Only through this cognitive struggle can students break through to the next level of personal beliefs. This unidimensional developmental theory became the catalyst for subsequent research and debate in the newly found field of personal epistemology. Though Perry contends his theory is not necessarily developmental in nature, going so far as to use the term *position* versus stage, his model is viewed within the context of stage theory by most scholars. As quoted by Hofer & Pintrich, (1997):

> The scheme itself and the inherent developmental mechanisms share much with other Piagetian-type developmental schemes. The positions appear to represent an invariant sequence of hierarchically integrated structures. Change is brought about through cognitive disequilibrium; individuals interact with the environment and respond to new experiences by either assimilating to existing cognitive frameworks or accommodating the framework itself (p. 91).

Perry purports that despite the fact that the positions within his theory are linear and sequential, movement throughout the positions is not necessarily continuous; each individual may demonstrate stagnant periods with little or no cognitive growth. Nonetheless, his model will be considered within a developmental framework for the purposes of the current inquiry. Although Perry undoubtedly must be credited with igniting the concept of personal epistemology, his work is not without criticism. His model was based solely on perceptions from volunteer undergraduate students at Harvard, and his sample was largely male. Although Perry attempted to modernize his research in later years, his results were never published. A summary of Perry's nine beliefs are included as Table 1.

Table 1. Perry's Summary of Students' Beliefs (1970)

1. Acknowledges absolute knowledge handed down by authority.
2. Acknowledges differences of opinion that are the result of poorly qualified authority.
3. Acknowledges uncertainty as temporary.
4. Acknowledges relativistic knowledge as the exception to the rule.
5. Acknowledges absolute knowledge as the exception to the rule.
6. Apprehends the need for personal commitment in a relativistic world.
7. Initial commitment is made.
8. Exploring commitment.
9. Acknowledges commitment as an ongoing, complex, and evolving process.

In the 1980s and 1990s King and Kitchener attempted to extend Perry's work through their intellectual developmental model, the Reflective Judgment Model. Focusing primarily on individuals' ability to cope with ill-structured problems, the duo theorized seven stages of students' developmental change in the justification of epistemological beliefs. As such, the idea is not intended to theorize the development of epistemological beliefs as much as the processes individuals use to judge and justify knowledge throughout each stage (King & Kitchener, 1994). At the earliest stage knowledge is viewed as absolute and disseminated by those in authority. As a result, no justification of belief is necessary as one must only passively accept knowledge to know the truth. As individuals' beliefs mature, they gradually grow to view knowledge as tentative and evolving. By the seventh stage, individuals consider knowledge subjective, with justification defined contextually. Judgment of justification also becomes significant in that some justifications are viewed as more valid or appropriate than others, depending upon context. Kitchener and King assert their model is purely developmental in nature, following a fixed and predictable sequence, and not everyone will reach the highest stage in the model. A summary of the stages of the Reflective Judgment Model is included as Table 2.

Table 2. Kitchener and King's Reflective Judgment Stages (1981)

1. Absolute knowledge is handed down by authority
2. Absolute knowledge exists, but is not necessarily immediately known.
3. Some knowledge is temporarily uncertain
4. All knowledge is uncertain. Hence, there is no way to determine which claim is correct or better.
5. Knowledge is subjective. Claims are made through subjective interpretation.
6. Objective knowledge is not possible. The knower plays an active role in constructing claims.
7. Knowledge is an ongoing process of inquiry and must be perceived as approximations of reality.

Another developmentalist, Marcia Baxter Magolda (1987; 1992), attempted unsuccessfully to quantify Perry's framework in her own studies. As Perry's scheme did not suitably fit her sample of undergraduate students, Baxter Magolda developed questions based on Perry's theory, incorporating the nature of knowledge and educational decision making. Developing an elaborate coding system, she then divided over 1,000 respondent results into similar categories which ultimately replaced Perry's first five positions. Utilizing this categorical system, she longitudinally analyzed the results to link the emergent categories to theory, thus leading to the development of her developmental framework, the Measure of Epistemological Reflection (MER) (Baxter Magolda, 1992). Baxter Magolda preferred to use the term *ways of knowing* in lieu of epistemological beliefs or reflective judgments, terms of Perry and Kitchener and King respectively. In this model four different ways of knowing are considered within unique epistemic assumptions: absolute knowing, transitional knowers, independent knowing, and contextual knowing. Baxter Magolda's work is credited with bridging the gender gap in epistemological study and being the most academically focused of all the developmental theorists. However, it is also criticized for including peripheral perspectives such as learner and instructor characteristics, as well as the evaluation of learning outcomes and instructional techniques (Buehl & Alexander, 2001). Hence, her inclusion of related constructs sparked the current dispute of the underlying nature of personal epistemology. Baxter Magolda was the first theorist to incorporate quantitative means for measuring epistemological beliefs. Through newly established quantitative assessment the dimensions of personal epistemological beliefs could be debated more empirically. This

difference of opinion among scholars will be expanded upon in later sections of the literature review.

Schommer's System of Independent Beliefs and Embedded Systemic Model

One of the most prevalent perspectives of personal epistemology is that of Schommer (1990; Schommer-Aikins, 2002) who proposed a multidimensional approach incorporating five comprehensive dimensions: the source, certainty, organization/structure, control, and speed of knowledge, proposed as a system of more or less independent beliefs (meaning beliefs may develop asynchronously). Although there has been disagreement among scholars as to whether the control and speed of knowledge acquisition should be viewed within the context of learning or intelligence theory rather than personal epistemology (Hofer & Pintrich, 1997), they have been included in the current theoretical framework to examine their possible contributions to personal epistemology and association with related constructs.

Individuals' beliefs of the source of knowledge may be viewed within a continuum ranging from faith in omniscient authority to belief in constructivist and active learning. Using the terms "naïve" and "sophisticated", Schommer asserts individuals with a naïve perspective view knowledge as created and disseminated by "omniscient" authorities (e.g., professors, researchers), hold negative beliefs about the average person's ability to understand intricate concepts, and believe in passively accepting information from authorities and experts. Individuals whose views fall in the more sophisticated end of the spectrum believe that through the process of inquiry knowledge can be personally constructed and evaluated. As a result, with proper access most people can eventually understand complex conceptions and challenge those in authority when warranted.

Authorities and experts may still be viewed as important resources, but not necessarily the creators of knowledge, omniscient, or infallible. Certainly these notions of the source of knowledge are broad generalizations and Schommer does recognize the variety of scenarios when the distribution between naïve and sophisticated views narrows. For instance, it is possible for an individual to hold both naïve and sophisticated views toward the source of knowledge depending on context. A student may actively question a professor to assist in construction of his or her own knowledge, but may passively accept knowledge from the government simply because it's the government, comprised of high ranking authorities who are "in the know". But beyond this, it is not unreasonable to suggest a seemingly naïve view of authority could in some cases prove quite sophisticated. For instance, an individual plagued with a computer virus may call IT support and follow the technician's instructions step by step, taking in such knowledge readily without question. In this scenario it may not be the best use of time or resources to meticulously question the IT technician or try to gain an in-depth understanding of the technical foundations of computer applications. Therefore, the passive acceptance of knowledge could be considered sophisticated in a practical sense, with consideration of time and relevance to the task at hand. Clearly, the nature of beliefs of the source of knowledge is somewhat relative.

It should be noted that source of knowledge is the one dimension of Schommer's theory that has not consistently emerged in factor analytic studies, even in those conducted by Schommer herself (Braten & Strømso , 2005; Qian & Alverman, 1995; Schommer, 1990; Schommer et al., 1992; Schraw et al., 2002). However, a recent unpublished study of individuals' personal epistemological beliefs of medical science did

reveal the source of knowledge to be a significant factor (Barnes, Bost Laster, McGaugh & Morse, 2007). This could be because medical knowledge is a unique matter in that medical authorities often have access to knowledge not typically pursued by most laypersons. While many areas of knowledge may be obtained through education or personal inquiry (math, science, language, etc.), knowledge of medicine (pathology, pharmacology, physiology) is not commonly mastered by most individuals. Consequently, reliance upon medical authority as a source of knowledge is often necessary. Therefore, the source of knowledge dimension may be domain dependent. For the current study, source of knowledge will be examined via exploratory factor analysis to examine the presence of this dimension.

Individuals' beliefs of the certainty of knowledge may be viewed within a continuum in which knowledge is viewed as absolute, factual, and ultimately attainable; to tentative, evolving, and elusive. A more naïve perspective incorporates the belief that knowledge is absolute and "there" waiting to be uncovered given enough time and resources. Diagnosing illness or researching problems are linear, logical processes, which will ultimately disclose the "right" solution or truth. Perspectives on the more sophisticated end of the spectrum view knowledge as dynamic, fallible, and ever-changing in light of new evidence. Diagnosing illness or researching problems are creative, constructed processes, prone to revision as more evidence becomes available. As with the source of knowledge, it is possible to hold naïve and sophisticated views simultaneously, and one's views may vary within context. Some research has determined students often view "hard" courses such as chemistry and algebra as comprised of more absolute and factual knowledge, while considering concepts in "soft" fields such as

philosophy or humanities more tentative and evolving (Braten & Strømso , 2005; Jehng, Johnson & Anderson; 1993; Lonka & Lindblom-Ylänne; 1996).

Beliefs of the organization/structure of knowledge may be considered within a continuum in which knowledge is understood to be simple, isolated pieces of information, to highly interrelated concepts which are contextual and theoretical in nature. On one end of the spectrum, individuals may view theoretical concepts as remote pieces of distinct, factual information. On the opposite end of the range, individuals may utilize theory in an integrated approach to synthesize knowledge and view knowledge as inherently holistic in nature. Again, though not explicitly referenced by Schommer until later years (2004), it is not unreasonable to consider one can hold both organizational views simultaneously, depending on context.

Control of knowledge acquisition can be viewed as a continuum representing the extent to which people hold a fixed or incremental view of the ability to acquire knowledge. This dimension is sometimes subdivided into beliefs about one's personal innate aptitude and beliefs about the innate aptitude of others. Individuals with a more naïve view of this dimension see the capacity for knowledge acquisition as something one is either born with or not. Because intelligence is fixed, some people can naturally understand complex issues while others cannot, regardless of exposure or education. Those with a more sophisticated outlook see the capacity for knowledge acquisition as adaptable; incremental through hard work and accessibility to resources. Given that intelligence is capable of change, most people can understand intricate matters with proper information and diligence. This dimension has been strongly argued within the research community. Though closely related to Dweck's intelligence theory (1988), some

insist control of knowledge is inherently intertwined with personal epistemology and crucial to the comprehensive examination of epistemology. The holistic union makes it impossible to examine one without the other; therefore, control of knowledge must contribute as a relevant dimension of epistemological beliefs (Schommer, 1990, 2001). Recent studies have found epistemological beliefs of intelligence are in fact; separate from traditional beliefs of intelligence, tentatively lending support to the inclusion of the dimension (Braten & Olaussen, 1998; Braten & Strømso , 2005). However, some scholars maintain although the construct of control is relevant to the study of knowledge, true epistemology must be examined in its purest form, disentangled from related constructs, however proximal they may seem (Buehl & Alexander, 2001; Hofer & Pintrich, 1997).

Speed of knowledge acquisition is viewed as a continuum in which knowledge is perceived as obtained quickly, to acquired gradually through continual effort and persistence. Individuals with views on the naïve end of the spectrum see learning as a quick process; if one is going to "get it" they will do so quickly or not at all. Those with a more sophisticated perspective see knowledge acquisition as a gradual process, sometimes requiring multiple attempts before knowledge can truly embed cognitively. Because speed of knowledge acquisition is a slow and steady process, complicated information must be examined methodically with potentially multiple reviews and revisions. As with the control of knowledge, the speed of knowledge acquisition is hotly debated among personal epistemology theorists with regard to its contributions to personal epistemology versus intelligence or learning theory. This debate will be expanded upon in subsequent sections.

Recently, Schommer-Aikins revised her theory somewhat, suggesting personal epistemological beliefs can fall within a cognitive frequency distribution rather than a continuum, implying that individuals may hold naïve and sophisticated views simultaneously and that one's views may fall more frequently on one side than the other, depending on context. She further revised her theory to propose that personal epistemology may most accurately be characterized as part of an embedded systemic model of beliefs, as epistemological beliefs do not exist in a cognitive vacuum, but rather a "system-among-other-systems" (2004). Within this model, beliefs of the control and speed of knowledge acquisition are viewed as separate entities from beliefs about knowledge and knowing. However, Schommer-Aikins is quick to point out these two sets of dimensions are active and highly reciprocal systems which work in tandem. Within this embedded model, epistemological beliefs may be viewed within a broader context, particularly with respect to their interactions among six additional systems: cultural relational views, beliefs of ways of knowing, beliefs about knowledge, beliefs about learning, classroom performance, and self-regulated learning.

Whereas Schommer's concept addresses the notion that personal epistemology is a complicated and dynamic phenomenon, and that individuals may hold multiple views within diverse contexts, it does not address the fact that scenarios eliciting such beliefs may vary in what constitutes a naïve or sophisticated response. Unfortunately, since the introduction of the embedded system model in 2004, Schommer-Aikins has yet to extensively expand upon her initial surmising, though she has found significant correlations between systems of ways of knowing; specifically, connected and separate knowing, and epistemological beliefs (Schommer-Aikins & Easter, 2006).

Other Perspectives

Incorporating beliefs from both developmental and independent theoretical perspectives, Hofer and Pintrich (1997) proposed a framework which organizes students' ideas of knowledge and knowing into *personal theories*. Although the authors acknowledge the multidimensionality of epistemological beliefs, they suggest these beliefs are logically organized and integrated into personal theories by each individual. The authors view beliefs about learning and education as peripheral to the model, focusing primarily on the nature of knowledge (certainty and simplicity) and the nature or process of knowing (source and justification) (Hofer 2001; Hofer & Pintrich 1997). Both researchers contend within the dimension of the nature of knowledge fall the certainty of knowledge and simplicity of knowledge. Within the dimension of the nature of knowing they suggest the source of knowledge and justification for knowing.

Hammer and Elby (2002; 2004) offer yet another epistemological perspective, focusing on the concept of *epistemological resources* rather than stages, theories, or beliefs. These various resources can be called upon at any given time for any circumstance. Resources for transitional knowledge support the premise that knowledge can be transferred from one to another. Resources for constructed knowledge allow the individual to view knowledge as personally constructed. In short, different types of knowledge elicit different resources for knowing. One of the most important implications from this line of thinking is the questioning of what constitutes naïve versus sophisticated belief. Typically, sophisticated epistemological beliefs hold that knowledge is tentative and ever-changing in light of new evidence. Though it is true many facets of knowledge can be viewed in such regard, Hammer and Elby challenge these broad speculations.

Though other scholars of epistemological research have referenced the importance of context, none have portrayed its significance in as straightforward of a manner as Hammer and Elby. As they state: "It is hardly sophisticated, for example, to consider it 'tentative' that the earth is round, that the heart pumps blood, or that living organisms evolve" (2002; p. 186). Therefore, utilizing effective epistemological resources in combination with various contexts can fulfill a more appropriate notion of sophisticated versus naïve belief.

Quantitative Measurements of Personal Epistemological Beliefs

This section is intended to introduce the reader to the quantitative measurements utilized in the current study: the Schommer Epistemological Questionnaire and the Epistemic belief inventory . Although the SEQ and EBI are not the only available instruments intended to analyze personal epistemological beliefs, they are included in this study to analyze their psychometric properties, as they are the most readily utilized measurements in personal epistemology research.

Schommer Epistemological Questionnaire

The SEQ was designed as a 5-point Likert style inventory to assess students' personal epistemological beliefs as represented through five separate dimensions: the source, certainty, control, speed, and structure of knowledge. Though the SEQ remains the most widely utilized instrument for assessing personal epistemological beliefs, its psychometric qualities are less than optimal for multiple reasons. Schommer's initial factor analytic assessments were heavily criticized for utilizing 12 item parcels rather than individual items, and the majority of her psychometric analyses failed to report internal reliability. Researchers have been unable to replicate her five factor model,

whether conducted at the parcel or item level; and several factor analytic studies conducted at the item level have produced three-factor models with simple and certain knowledge combined (Braten & Strømso , 2005; Qian & Alvermann, 1995; Schraw, et al., 2002; Wood & Kardash, 2002). Alpha coefficients of the SEQ range from .10 to .85, accounting for 46 - 53% of the variance in common (Qian & Alvermann, 1995; Schommer, 1993; Schommer et al, 1992; Schraw et al., 2002).

Schommer created the SEQ in 1990 and attempted to replicate its factor structure in subsequent studies (Schommer, 1993a; Schommer, 1994; Schommer et al., 1992). To tap into the five hypothesized dimensions of personal epistemological beliefs, Schommer created 63 items divided into 12 subsets (see Table 3). Some of the dimensions are represented by several subsets, others by just one. In her series of validation studies, the number and structure of factors of the SEQ varied considerably. For example, in her 1990 study, factor analysis revealed four factors which Schommer labeled as Innate Ability, Simple Knowledge, Quick Learning, and Certain Knowledge. In this study only eight of the 12 hypothesized subsets loaded on a factor, based on a cut-off of .40, and some of the subset loadings were not consistent with Schommer's initial hypothesis. For example, the subset Avoid Ambiguity loaded on Simple Knowledge, rather than Certain Knowledge, as originally hypothesized. Learn the first time, which was hypothesized as Quick Learning, loaded on the Innate Ability factor.

In Schommer's second study (1992), factor analysis revealed a three factor solution, with Innate Ability and Quick Learning merging into one factor. A four factor solution was then forced, and based on Confirmatory Factor Analysis results, was deemed a better fit for the data. A third attempt at confirming the results was conducted

with high school students in 1993, yielding a four factor solution when utilizing an eigenvalue of .98 as a cutoff point. A final validation study was conducted in 1998 with working adults, which revealed a four factor solution similar in structure to the previous studies. At the same time as Schommer continued to promote the four factor solution in later studies, in should be noted that four of the 12 item subsets failed to load, or loaded inconsistently at the .40 level throughout the series of studies. Tables 3 and 4 summarize attempts of replication by Schommer and others.

Table 3: A Comparison of Schommer's Factor Structures Across Studies Utilizing Item Parcels

Parcel	Schommer (1990) College Students	Schommer et.al. (1992) College Students	Schommer (1993) High School Students	Schommer (1998) Working Adults
1. Learn first time	Innate Ability (.62)	Innate Ability (.44)	Innate/Fixed Ability (.45)	Fixed Ability (.46)
2. Can't learn how to learn	Innate Ability (.56)	Innate Ability (.61)	Innate/Fixed Ability (.64)	Fixed Ability (.85)
3. Success is unrelated to hard work	Innate Ability (.55)	Innate Ability (.51)	Innate/Fixed Ability (.51)	--
4. Ability to learn in innate	--	--	Quick Learning (.49)	--
5. Avoid ambiguity	Simple Knowledge (.68)	Simple Knowledge (.64)	Simple Knowledge (.55)	Simple Knowledge (.58)
6. Seek single answers	Simple Knowledge (.56)	Simple Knowledge (.46)	--	Simple Knowledge (.60)
7. Avoid integration	Simple Knowledge (.54)	Simple Knowledge (.43)	Simple Knowledge (.41)	Simple Knowledge (.52)

8. Don't criticize authority	--	--	Fixed Ability (.40)	--
9. Depend on authority	--	Simple Knowledge (.46)	--	--
10. Learning is quick	Quick Learning (.72)	Quick Learning (.63)	Quick Learning (.51) Innate/Fixed Ability (.45)	Quick Learning (.73)
11. Knowledge is certain	Certain Knowledge (.53)	--	Certain Knowledge (.54)	Certain Knowledge (.62)
12. Concentrated effort is a waste of time	--	Innate Ability (.52)	--	--

Table 4: A Comparison of Factor Structures Across Studies Utilizing Item Parcels

Parcel	Schommer (1990)	Chan & Elliot (2000)	Clarebout et al. (2001) Sample 1	Clarebout et al. (2001) Sample 2
1. Learn first time	Innate Ability (.62)	Fixed/Innate Ability (.41)	--	--
2. Can't learn how to learn	Innate Ability (.56)	Fixed/Innate Ability (.69)	--	--
3. Success is unrelated to hard work	Innate Ability (.55)	Fixed/Innate Ability (.61)	--	--
4. Ability to learn in innate	--	Certain Knowledge (.61)	Quick Learning (.54)	--
5. Avoid ambiguity	Simple Knowledge (.68)	Certain Knowledge (.48)	Simple Knowledge (.59)	Simple Knowledge (.56)
6. Seek single answers	Simple Knowledge (.56)	Certain Knowledge (.35)	Certain Knowledge (.51)	--
7. Avoid integration	Simple Knowledge (.54)	Fixed/Innate Ability (.35)	--	Simple Knowledge (.53)
8. Don't criticize authority	--	Omniscient Authority (.80)	Certain Knowledge (.55)	--

9. Depend on authority	--	Certain Knowledge (.31)	Simple Knowledge (.50)	--
10. Learning is quick	Quick Learning (.72)	Omniscient Authority (.40)	Quick Learning (.52)	--
11. Knowledge is certain	Certain Knowledge (.53)	Omniscient Authority (.43)	Certain Knowledge (.51)	Certain Knowledge (.79)
12. Concentrated effort is a waste of time	--	Fixed/Innate Ability (.32)	--	--

Epistemic belief inventory

The Epistemic belief inventory (Schraw, Bendixen, & Dunkle, 2002) is a five point Likert style inventory consisting of 32 items designed to measure five dimensions of personal epistemological beliefs. The EBI was constructed as a condensed version of the SEQ with the aim to produce a more efficient instrument with improved psychometric qualities. Items were developed and retained to reduce the number of questions from the SEQ while still incorporating all five of Schommer's hypothesized dimensions: the source, certainty, structure/organization, control, and speed of knowledge. Alpha coefficients range from .58 to .87 with test-retest correlations reported from .62 to .81 (Duell & Schommer-Aikins, 2001; Wheeler, 2007), accounting for 60% of the variance in common (Schraw et al., 2002). Though not ideal, most scholars consider the EBI a more reliable and valid measurement to quantify personal epistemological beliefs than the SEQ. Unfortunately, the only additional validation study of the EBI is a doctoral dissertation which remains unpublished (Huglin, 2003). Nevertheless, the EBI has been utilized to measure personal epistemological beliefs in multiple studies.

Current Research

As the scholarly interest in personal epistemology has increased the past several years, studies investigating various facets of the construct have been conducted, as well as attempts to link it to potentially related cognitive constructs. This section provides a brief overview of current research topics of relevance to the current study.

Domain generality versus domain specificity

A current issue in personal epistemology research is the concept of domain-general versus domain-specific beliefs. Some research has evidenced personal epistemological beliefs may vary as a function of academic domain. In their study of medical students, Lonka and Lindblom-Ylänne (1996) found psychology students held more relativistic views of knowledge than medical students, who portrayed knowledge as primarily dualistic. Studying undergraduate students from various academic majors, Hofer (2000) found students considered knowledge in science disciplines to be more certain than in the field of psychology. These same students also considered experts and authorities to be the source of knowledge in science, but believed individuals could more realistically construct their own knowledge in psychology. Similarly, Braten and Strømso (2005) found undergraduate students in business administration had stronger beliefs in fixed intelligence than those in education. The general trend in this line of research has pointed to differences of belief between so-called *hard* and *soft* fields of knowledge. According to Biglan's classification of academic fields (1973a, 1973b), hard academic fields uphold a unified paradigm, often concerned with practical application. Therefore, subjects such as physical and biological sciences may be considered hard due to their tendency toward paradigmatic and universally agreed-upon content and methodology. Conversely, subjects such as humanities and education often employ more idiosyncratic tendencies in content and methodology and therefore may be considered soft. Biglan further divided domains of inquiry into *pure* and *applied*, with pure fields focusing on the generation of theory and applied fields focusing more on practical application. As research suggests, many individuals hold more naïve views of knowledge in hard fields versus soft. A successive question then becomes whether

inherent differences exist between hard and soft fields or if traditional pedagogy plays a more relevant role.

Traditionally in American education, differing academic fields are often instructed in diverse ways. The pedagogical approaches used in math and science are typically more oriented to discovering an ultimate answer or result based on proven criteria. Approaches utilized in education or social service fields often lend themselves to exploration and discovery, with multiple perspectives and methods accepted. Drawing on their contextualist resource view of personal epistemology, Hammer and Elby (2002) propose students who learn in active, creative learning environments are more likely to exhibit sophisticated epistemological beliefs than those in traditional lecture-dense or instructor-driven environments. However, as quoted by Braten and Strømso (2005): "Where the same students are asked about their epistemological beliefs with respect to different fields, academic domain and instructional context are likely to be confounded, because students will associate the targeted domains with different instructional experiences" (p. 546). To that end, it has thus far proven difficult to determine how epistemological beliefs are related to the nature of domains versus the pedagogical nature of such disciplines (Braten & Strømso , 2005; Buehl & Alexander, 2001; Hammer & Elby, 2002; Hofer, 2000; Hofer, 2004).

Obviously, the idea of domain generality versus specificity, particularly with potential confounds such as academic discipline and instruction, is quite complex. Due to such intricacy it may be too simplistic to assume a dichotomous pattern in epistemological beliefs. Therefore, some assert personal epistemology beliefs can be both domain general and specific, depending on context (Buehl & Alexander, 2001;

Hofer, 2000; Schommer-Aikins, 2002; Schraw, 2001). While most may hold particular beliefs about the nature of knowledge in daily contexts, individuals may vary their beliefs when it comes to scientific or mathematical notions where concepts are often viewed as precise, proven, and universally agreed upon by experts. Along these lines, Schraw (2001) has suggested that though domain-general beliefs may serve as an undercurrent for basic academic motivation or engagement, domain-specific beliefs may come into play for specific tasks in the academic context. Though the literature base is growing, more research regarding domain generality versus specificity is needed.

Relationship to Learning, Academic Cognition and Performance

Multiple studies have suggested strong relationships between personal epistemological beliefs and learning outcomes. Ryan (1984) utilized Perry's dimensions of dualist and relativist beliefs in one of the first attempts to link epistemological beliefs with academic outcomes. He determined students with more relativistic beliefs exhibited better reading comprehension outcomes than those with a dualistic view. He also linked relativistic beliefs with a higher grade point average, while controlling for academic aptitude and previous experience. In her initial studies of epistemological beliefs Schommer found undergraduate students with beliefs in quick and certain knowledge typically generated oversimplified and inappropriately absolute conclusions in reading comprehension. Belief in quick learning was also associated with overconfidence in test performance and negatively associated with grade point average (1990; 1993). Other studies have confirmed such results (Garett-Ingram 1997; Hofer, 2002; Schraw et al., 2002).

Schommer also found students with more naïve views of knowledge may view being a "good" student as passively observing in the classroom, taking scrupulous notes to later be memorized. Because knowledge is disseminated by the "omniscient" professor, the student's job is to readily accept such knowledge, with the aim of regurgitating facts. Such facts can potentially be memorized quickly, as they are conceived to be simple in nature and relatively isolated. Seeing as the facts are certain, there is no need for contemplation or questioning. Students with such perspectives may feel helpless or frustrated if assigned a project that requires them to develop their own hypothesis or conclusion about a given topic, rendering completion of such a project impossible if the professor won't tell them how to do it. The same students may feel more comfortable in large lecture-dense courses than in small discussion groups. Interestingly, the traditional curricula and pedagogy of undergraduate education seem to correspond with students' transition from naïve to sophisticated views. Most freshman courses are large and heavy in lecture, particularly those satisfying general education requirements. Due to size and time limitations, professors often rely on traditional instruction and multiple choice or true/false exams. As students progress to upper division coursework their views of knowledge typically become more sophisticated, while at the same time the curricula and pedagogy often become more specific and problem-based in nature. Though there are certainly exceptions to this scenario, it does cause one to consider; is our traditional pedagogy helping or hindering students' ascension to more sophisticated epistemological beliefs? Would students exhibit more sophisticated views if freshman year started with small and creative discussion groups rather than large, lecture-dense general studies? To date there have been no published studies comparing the

epistemological beliefs of same-year students from schools that incorporate innovative teaching approaches in small classes to large traditional universities. Such an examination could prove an interesting extension for further inquiry.

Relationship to Motivation and Strategy Use

Studies linking personal epistemological beliefs with student motivation are somewhat sparse, and several scholars have called for additional studies of the two (Braten & Strømso , 2005; Hofer, 2002; Hofer & Pintrich, 1997). The studies which have been conducted found beliefs in quick learning, certain knowledge, and fixed ability to be negatively associated with use of effective cognitive and meta-cognitive strategies (Braten & Strømso , 2005; Dahl, Bals & Turi, 2005; Dweck & Leggett, 1988; Kardash & Howell, 2000; Schommer, 1992). Garrett-Ingram (1997) found belief in complex, integrated knowledge was positively related to self-efficacy and control beliefs, as well as task value and intrinsic goal orientation as measured by the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia & McKeachie, 1991). Neber and Schommer-Aikins (2002) found sophisticated epistemological beliefs to be positively related to self-efficacy and mastery goal orientation. Braten and Strømso (2005) found naïve epistemological beliefs were negatively related to students' perceived self-efficacy, mastery goal orientation and self-regulatory strategy use, as measured by the MSLQ.
For the current study, multiple regression will be utilized to examine the relationship between scores from second order factors and scores from the motivation and learning strategy sections of the MSLQ to examine the magnitude of their associations. Based on research, it is hypothesized that individuals with more naïve epistemological beliefs will report greater use of rehearsal strategies and less effective use of strategies such as

elaboration, critical thinking, and organization strategies, as well as exhibit less internal motivation for persistence and academic success.

Calls for Disentanglement

By far, the most widespread theme in much of the current research is the call for an accurate definition of personal epistemology, disentangled from related constructs. Since its inception, researchers of personal epistemology have yet to agree on a single definition for the construct, primarily due to its strong relationships with similar constructs such as intelligence, and learning and teaching theory; as well as the lack of credible quantitative measurements. The problem has become so pervasive, many researchers have issued a plea, imploring scholars to definitively characterize the construct and thoroughly separate "pure" personal epistemology from related concepts. According to some, (Buehl & Alexander, 2001; Hofer, 2001; Hofer & Pintrich, 1997) the nature of knowledge and the nature of knowing are the only two concepts which accurately define personal epistemology, specifically contending the dimensions of the control and speed of knowledge acquisition more accurately relate to implicit theories of intelligence. Dweck's implicit theory of intelligence suggests two dichotomous beliefs of the nature of intelligence. On one hand, individuals may view intelligence as inherently fixed, or incapable of significant change. On the other hand, individuals may consider intelligence malleable and capable of change given appropriate conditions (Dweck, 1988). Within the context of this theory, individuals who believe intelligence is fixed may be likely to believe that learning takes place quickly or not at all, depending on the nature of one's own ability. Those holding this view may also likely believe individuals have no control over their ability to acquire knowledge, and are therefore passive

receivers of knowledge. Some advocate that even though these concepts may peripherally relate to Schommer's dimensional framework, they do not intrinsically define personal epistemological beliefs, in that such beliefs are psychological traits of the individual. Therefore, it is contended that though beliefs of the nature of knowledge and the nature of intelligence correlate, they actually represent separate constructs.

A second consideration is how personal beliefs of knowing and intelligence are tapped and whether such techniques measure analogous constructs. Whereas speed and control of knowledge items on Schommer's SEQ are assessed by the perceived relationship between hard work and success in gaining knowledge, Dweck's measurement of beliefs are assessed by directly asking participants if intelligence can be modified. There is some debate as to whether these two instruments measure the same, or similar but separate perspectives. In their study of undergraduate students, Braten and Olaussen (1998) found students who were directly asked if one's intelligence could be modified offered quite different responses than when asked about descriptive qualities of intelligence with the term "intelligence" avoided. For example, many students answered affirmatively when asked if characteristics of intelligence such as attention, critical thinking and logical reasoning could be modifiable. The majority of these same students responded negatively when asked if intelligence could be modified, therefore undermining their initial response. Braten and Strømso (2005) also determined students' scores from all dimensions of personal epistemological beliefs were statistically unrelated to those from Dweck's Implicit Theories of Intelligence. In their words: "Apparently, there is a difference between asking students directly about how modifiable they think intelligence is and asking them about the speed of learning and the ability to learn" (p.

558). For the current study, it is hypothesized that participants' implicit theories of intelligence will be only minimally related to the epistemological dimensions of intelligence, namely speed and control of knowledge.

The inclusion of speed of knowledge acquisition has also been criticized, with some advocating its relationship to learning theory rather than personal epistemological beliefs (Buehl & Alexander, 2001; Hofer, 2001; Hofer & Pintrich, 1997). As stated by Hofer & Pintrich (1997): "a belief about what knowledge is and how it can be described is not the same as a belief about how quickly one might go about learning" (p. 109). However, in reality it may prove relatively difficult to separate the two. A belief about how quickly one might go about learning is a belief of how quickly knowledge can be acquired, which could in a sense be descriptive of knowledge itself. When describing objects most people tend to portray them in a holistic way. If one were to describe a turtle it is not unreasonable to include its color, soft body with a hard shell, the fact that some snap or bite, and that all move slowly. If one were to describe a car we would certainly expect this definition to include gas mileage and how quickly it can go from 0 to sixty miles per hour. To that end, an accurate description of knowledge may potentially include the speed of its acquisition.

Though undoubtedly this debate will continue among researchers for some time, the present study assumes the control and speed of knowledge acquisition to be integrally related to personal epistemology and will be examined as such. Admittedly, one could give pause to consider these dimensions within related perspectives rather than personal epistemology. But, it is feasible for the control and speed of learning to contribute directly to personal epistemology, learning theory, and implicit theories of intelligence

simultaneously. In the realm of human cognition and behavior it is quite practicable to assume constructs may contribute to more than one phenomenon. Moreover, personal beliefs of knowledge hardly seem autonomous and though the call has been raised to disentangle personal epistemology from related beliefs definitively, it may be rather implausible and impractical to do so.

Despite previous attempts, thus far it has proved impossible to definitively disentangle personal epistemological beliefs from similar constructs. The process of knowing is a dynamic phenomenon of cognitive acquisition which appears so intimately related to learning and intelligence that none can be separated. However, in support of their endorsement to limit the defining properties of personal epistemology Hofer and Pintrich (1997) state:

> We recognize that beliefs about learning, intelligence, and teaching are related to epistemological beliefs…however, we think that this delimitation of the construct will provide clarity to the research and theorizing in the field and lead to more progress in our understanding of the structure and function of epistemological beliefs than more global and inclusive definitions (p. 117).

Conversely, elimination of such strongly related constructs may confuse rather than clarify the situation. As stated by Dahl, Bals and Turi (2005): "The strong correlations among fixed and the other beliefs measured by the SEQ suggest that beliefs about intelligence should not be ignored in research devoted to understanding the relationship between beliefs and actions" (p. 271). Accordingly, for present purposes the comprehensive and holistic theoretical framework espoused by Schommer and others will be utilized as the foundation of personal epistemology. The current study does not seek

to offer yet another definition of personal epistemology. The study does intend to investigate the underlying nature of personal epistemological beliefs by examining the most prominent instruments to assess such beliefs.

Summary

The study of personal epistemology has important implications in both pure and applied areas of education. However, before practical benefits can truly be gleaned, researchers of personal epistemology must clarify more definitively the nature of the phenomenon and its associations with related constructs. To this point, research has established personal epistemology as a multi-faceted, subjective construct which is adaptable with age, level of education, and potentially academic domain. Research has also verified personal epistemological beliefs affect academic outcomes. However, the true nature of the construct is still fairly ambiguous, and to date no study has utilized hierarchical factor analysis to assess underlying dimensions. Therefore, this study is a continued attempt to add clarity to the study of personal epistemology by investigating further the structure and psychometric properties of available instruments, as well as the foundations of the construct itself.

CHAPTER III

METHODOLOGY

The purpose of this chapter is to describe the sample characteristics of the current inquiry, and to highlight various other methodological elements such as instruments utilized, data collection procedures, and statistical analyses.

Participants

The sample included undergraduate students from a large public university in the Midwest who were enrolled in various one and two thousand level general psychology courses. Four hundred eighty-five students were recruited through Sona, an on-line service utilized by the psychology department at the participating university which links students to research opportunities. Students in psychology courses at the participating university are typically required to earn five "units" of participation in a research process. One unit of research experience is considered one hour of participation in a research project. Individuals who participated in the current study received one unit of research experience. Participation was strictly voluntary and participants remained anonymous. No names or other identifying information were requested or collected, including e-mail addresses and other on-line identification. Data collection began January 2009 and concluded May 2009.

Design

The current inquiry utilized factor analytic methods to examine the internal structures of two measurements of personal epistemological beliefs: the Schommer

Epistemological Questionnaire and the Epistemic belief inventory . The study also examined the psychometric properties of each instrument and sought to determine if a hierarchical factor structure emerges from the subscales across the SEQ and EBI. Multiple regression (MRA) was utilized to explore the relationship between potential factors and associated constructs of motivation, use of strategy, and implicit theories of intelligence, as measured by the Motivated Strategies for Learning Questionnaire and Implicit Theories of Intelligence Scale, respectively.

Instruments

This section provides a brief description of the instruments utilized in this study, as well as the demographic information of participants.

Demographic Information

A brief demographic questionnaire was included in the data collection (Appendix A). Requested information included age, gender, ethnicity, academic classification, and college major. Four hundred eighty-five students participated in the study, ranging in age from 20 to over 40. The majority of participants were female, Caucasian, and between 20 and 22 years of age. No identifying information (names, student I.D. number etc.) was requested and all data were destroyed following the completion of the study. A detailed description of participant demographics is provided in Table 5.

Table 5: Frequencies and Percentages of Demographic Variables

		N	***Percentage***
Gender			
	Male	163	40.6%
	Female	235	58.6%
	No response	3	0.7%
Age			
	20-22	365	91.0%
	23-25	21	5.2%
	26-28	4	1.0%
	29-31	3	0.7%
	32-34	2	0.5%
	35-37	1	0.2%
	38-40	0	0.0%
	>40	2	0.5%
	No response	3	0.7%
Ethnicity			
	African-American	20	5.0%
	Asian	10	2.5%
	Caucasian	325	81.0%
	Hispanic/Latino(a)	8	2.0%
	Native American	25	6.2%
	Other	10	2.5%
	No response	3	0.7%
Classification			
	Freshman	180	44.9%
	Sophomore	103	25.7%
	Junior	65	16.2%
	Senior	50	12.5%
	No response	3	0.7%

Schommer Epistemological Questionnaire

The SEQ was designed as a 63-item 5-point Likert-style inventory to assess students' personal epistemological beliefs as represented through five separate dimensions: the source, certainty, control, speed, and structure of knowledge. Students are asked to choose the option that best represents their degree of agreement or disagreement with 63 statements. Options range from 1 *strongly disagree* to 5 *strongly agree*, and items are presented from a naïve viewpoint (see Appendix B). To date, the SEQ remains the most widely utilized instrument for assessing personal epistemological beliefs. Alpha coefficients of the SEQ range from .10 to .85, accounting for 46 - 53% of the variance in common. As many validation studies have utilized Schommer's item parcels for factor analysis, the current inquiry assesses each item individually. The SEQ was included in this study is to assess its theoretical structure and integrity, and to determine if a hierarchical structure with the EBI exists.

Epistemic belief inventory

The Epistemic belief inventory (Schraw et al, 2002) is a 5-point Likert-style inventory which was designed as a condensed version of the SEQ. Thirty-two items were designed to measure five dimensions of personal epistemological beliefs: innate ability, simple knowledge, certain knowledge, omniscient authority, and quick learning. Options range from 1 *strongly disagree* to 5 *strongly agree*, and like the SEQ, items are presented from a naïve viewpoint (see Appendix C). Alpha coefficients range from .58 to .87 with test-retest correlations reported from .62 to .81, accounting for 60% of the variance in common. The purpose of including the EBI in the current study is to assess its theoretical structure and integrity, and to determine if a hierarchical structure with the SEQ exists.

Motivated Strategies for Learning Questionnaire

Developed in 1991, the MSLQ (Pintrich, Smith, Garcia & McKeachie) is an 81-item self-report instrument consisting of six motivation subscales and nine learning strategy scales. Utilizing a social-cognitive framework, it is intended to measure motivation and perceived learning strategies as they vary among individuals. Underlying assumptions of the social-cognitive framework depict motivation and learning strategies as dynamic, contextually-bound processes which can be self controlled. The motivation section of the instrument is comprised of 31 items divided into six subscales which assess students' goals, values, beliefs about imperative skills for success, and test anxiety. The learning strategy section consists of 31 items divided into nine subscales which assess students' use of various cognitive and metacognitive strategies in the classroom, and assess management of different resources. For the current study, only 11 subscales representing motivation and the cognitive aspects of learning strategy were used. The resource management subscales were not utilized, as they had no bearing on the research question. Reliability estimates for the MSLQ are diverse, ranging from .62 to .93 for the motivational scales and .52 to .80 for the learning strategies scales (Mental Measurements Yearbook 13).

It should be noted the MSLQ was originally intended to analyze the aforementioned constructs specifically at course level. However, other similar measurement options directed at a general academic context, such as the 2nd edition Learning and Study Strategies Inventory (LASSI) have raised some psychometric concerns in regard to structure and theoretical foundations (Eldredge, 1990; Loo, 1999; Melancon, 2002; Murphy & Alexander, 1998; Olivarez & Tallent-Runnels, 1994).

Although reliabilities for the LASSI are typically good (.73 to .89), there are questions as to whether it truly assesses the ten underlying constructs purported by the authors, as they do not offer any empirical evidence of internal or external validity. Consequently, according to the Buros Mental Measurement Yearbook (17) the LASSI does not meet the minimum accepted psychometric standards for substantiating validity evidence established in the Standards for Educational and Psychological Testing (Wilkinson; APA, 1999). Moreover, though the authors of the LASSI contend the underlying theoretical structure is related to skill, will, and self-regulation, some have found the underlying structure better represented as effort-related activities, goal orientation, and cognitive activities (Prevatt et al., 2006). Given these reasons, the MSLQ was selected as the best possible option for the present study. To help offset the course-oriented language of the MSLQ some original questions were altered to incorporate more general language. For instance, questions which state "in this course" were changed to "in most courses" to capture a more global view of student motivation and use of strategy. The adapted questionnaire may be found in Appendix D. The MSLQ was included in the current inquiry to examine the relationship between scores from the SEQ and EBI, and scores from the motivation and learning strategy subscales.

Implicit Theories of Intelligence Scale

The Implicit Theories of Intelligence Scale (TIS) (Dweck, 1988) is a unidimensional 8- item, Likert scale measurement intended to determine one's implicit theory of intelligence (see Appendix E). The scale divides beliefs of intelligence into two dichotomous notions: entity and incremental views of intelligence. The belief that intelligence is inherent and fixed (incapable of significant change) is considered an entity

perspective, while the belief that intelligence is malleable and capable of change is considered incremental. Psychometric qualities of the instrument have consistently proved highly acceptable. Several studies have analyzed the reliability of the scale, producing alpha coefficients of internal consistency from .94 to .98, as well as a test-retest correlation coefficient equal to .80 (Wheeler, 2007). In five separate factor analyses, three distinct factors emerged with identical structures across all studies with factor loadings from .74 to .96. The factors were named implicit theory of intelligence, implicit theory of morality, and implicit theory of the world. These results provide evidence that one's implicit theory of intelligence may be distinct from one's implicit theory of morality or the world (Dweck, Chiu, & Hong, 1995).

Though the psychometric properties of the TIS are highly acceptable, it should be noted the only published reliability and validity studies were conducted on a condensed scale which consisted of three entity items. To date, psychometric studies of the eight-item version have not been published. However, given its psychometric soundness in a condensed level and widespread use in behavioral studies, it was included in the present study to examine the association between epistemological beliefs (as measured by the SEQ and EBI) and personal theories of intelligence.

Procedure

Utilizing Sona, students were given the option to partake in the current study to receive extra credit in participating undergraduate psychology courses. Students were informed their participation was strictly voluntary and provided a copy of the IRB approved informed consent sheet and IRB contact information. Students were also informed of their rights as participants and the purpose of the study. Students

participated in the study anonymously, with no names or identifying characteristics with which to identify them. Instruments included on the Sona website were a brief demographic survey and informed consent (Appendix A), the Schommer Epistemological Questionnaire (Appendix B), the Epistemic belief inventory (Appendix C), the Motivated Strategies for Learning Questionnaire (adapted to apply to multiple courses; Appendix D), and the Implicit Theories of Intelligence Scale (Appendix E). All collected data were stored on a secure network drive within the university system and deleted after download of the information to the researcher's secure network drive. The study was available via Sona the spring semester of 2009. Downloaded responses were transferred to an excel spreadsheet which was in turn merged into SPSS 14.0. Thirty-four items were then reverse coded as appropriate. Statistical analyses included descriptive statistics, reliability analysis, zero-order correlations among the major study variables, principal axis factoring (PAF), and multiple regression analysis (MRA).

CHAPTER IV

FINDINGS

The purpose of this chapter is to provide the results of the various statistical analyses employed to address the following research questions:

1. What is the internal structure of the Schommer Epistemological Questionnaire?
2. What is the internal structure of the Epistemic belief inventory ?
3. Does a hierarchical factor structure exist across the two measures?
4. What is the nature of the relationship between second order factors and motivation, use of strategy, and implicit theories of intelligence?

The first two questions were addressed through the use of principal axis factoring to determine the underlying structures of the SEQ and EBI. The emergent factors were subjected to oblique rotation for further clarification and interpretation. Internal consistency reliability was also analyzed to examine the psychometric properties of each instrument. Principal axis factoring of factor scores was conducted to address the third research question: Does a hierarchical structure exist across the two measures? To address the fourth research question, multiple regression was utilized to examine the association between factor scores from both the SEQ and EBI and the motivation and learning strategy subscale scores from the MSLQ, as well as scores from the TIS.

Structural Analysis of the Instruments

This section reports results from the internal structural analyses of the SEQ and EBI, specifically highlighting the results of the PAF and internal consistency reliability analyses. Discussion of the presence of higher order factors is also included.

Schommer Epistemological Questionnaire

Similar to previous studies, the current inquiry revealed many questionable characteristics within the SEQ. Overall reliability analysis for the SEQ produced an alpha coefficient of .64 (N = 63) with individual scales ranging from .16 (knowledge is certain) to .47 (don't criticize authority). It is notable that the certainty of knowledge dimension, which has not emerged in studies consistently, produced a particularly low alpha. Prior to principal axis factoring the bivariate correlation matrix was visually inspected as a preliminary assessment of inter-item correlation. Most values were in the low to moderate range (.00-.35). The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was then calculated, which is a ratio of the sum of the squared correlations to the sum of the squared correlations plus squared partial correlations. As the partial correlations decrease in size, which indicates distinct factors may emerge from the factor analysis, the KMO value will approach 1.0. Thus, the KMO is useful to predict if data are likely to factor well. The KMO value for the SEQ was acceptable at.76, indicating factor analysis was appropriate for the scale. Additionally, Bartlett's Test of Sphericity was significant [$\chi^2(1953) = 5618.590$; (p=.000], which rejected the null hypothesis that the correlation matrix was an identity matrix. By rejecting the null hypothesis the correlation matrix was deemed acceptable for factor analytic techniques. Initial results revealed small to moderate communalities ranging from .22 to .49, and 20 factors with

eigenvalues greater than 1.00, accounting for 58.62% of variance. Upon inspection of the scree plot and parallel analysis (see Figures 1 and 2), and judging from previous theory, three factors were retained accounting for 21.78% of variance in common. Following Promax rotation, the pattern and structure matrices were inspected to determine factor loadings. Oblique rotation was utilized, as theoretically, the emergent factors should be correlated. However, the factor correlation matrix indicated fairly independent dimensions with factor correlations ranging from .19 to -.23. Significant factor loadings were moderate, ranging from -40 to .60, with no cross loading items; 36 items did not load significantly on any factor (see Table 6). The three factors were named Innate Ability to Acquire Certain Knowledge (λ= 6.34; 10.07% of variance), Simple Knowledge (λ= 4.81; 7.63% of variance), and Certain Knowledge (λ= 2.56; 4.06% of variance)

Figure 1: SEQ Scree Plot

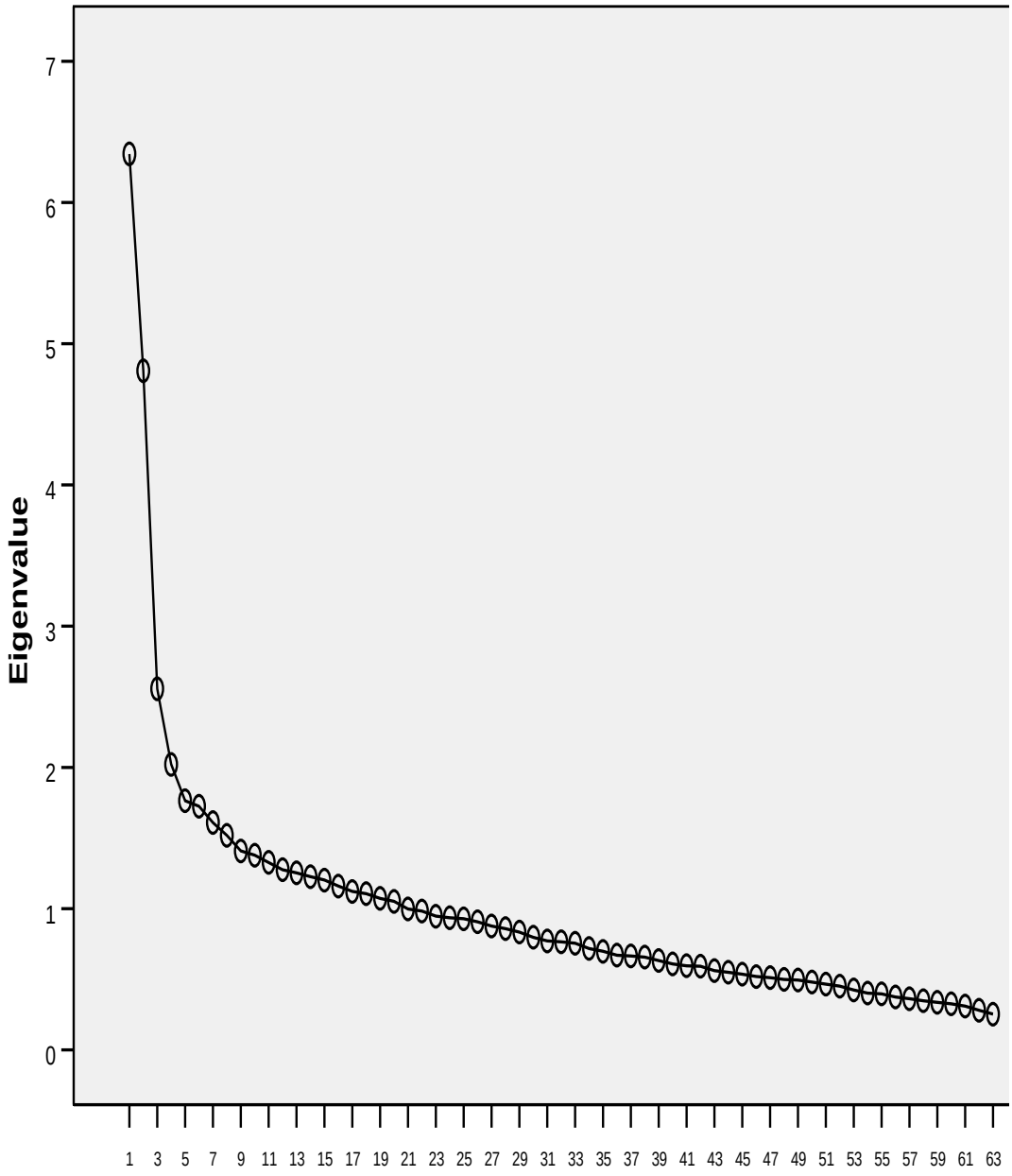

Figure 2: SEQ Parallel Analysis

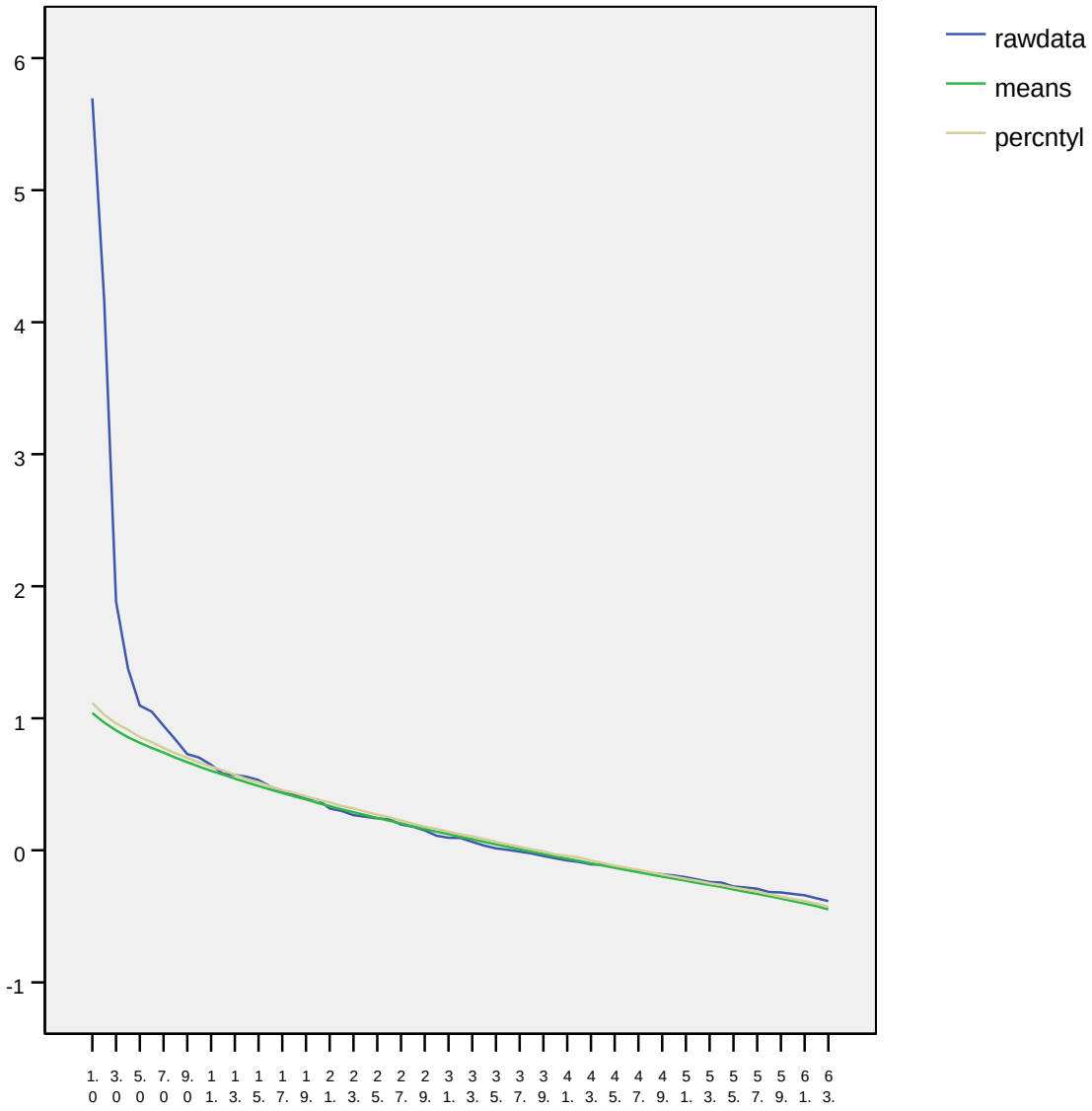

Table 6: Factor Loadings and Communalities (h^2) for the Schommer Epistemological Questionnaire

Item	Factor 1 Innate Ability to Acquire Knowledge	Factor 2 Simple Knowledge	Factor 3 Certain Knowledge	h^2
If you are ever going to be able to understand something, it will make sense to you the first time you hear it.				
The only thing that is certain is uncertainty itself.				
For success in school, it's best not to ask too many questions.		.40		*.34*
A course in study skills would probably be valuable.				
How much a person gets out of school mostly depends on the quality of the teacher.				
You can believe almost everything you read		.42		*.37*
I often wonder how much my teachers really know.				
The ability to learn is innate.				
It is annoying to listen to a lecturer who cannot seem to make up his mind as to what he really believes.				
Successful students understand things quickly.		.46		*.40*

A good teacher's job is to keep his students from wandering from the right track.			
If scientists try hard enough, they can find the truth to almost anything.			
People who challenge authority are over confident.			
I try my best to combine information across chapters or even across classes. (*Reversed*)	.44		*.33*
The most successful people have discovered how to improve their ability to learn. (*Reversed*)	.60		*.49*
Things are simpler than most professors would have you believe.			
The most important aspect of scientific work is precise measurement and careful work.			
To me studying means getting the big ideas from the text, rather than details.			
Educators should know by now which is the best method, lectures or small group discussions.		.42	*.37*
Going over and over a difficult textbook chapter usually won't help you understand it.			

Scientists can ultimately get to the truth.		
You never know what a book means unless you know the intent of the author.		
The most important part of scientific work is original thinking.		
If I find the time to re read a textbook chapter, I get a lot more out of it the second time. (*Reversed*)	.43	*.44*
Students have a lot of control over how much they can get out of a textbook. (*Reversed*)	.42	*.37*
Genius is 10% ability and 90% hard work.		
I find it refreshing to think about issues that authorities can't agree on.		
Everyone needs to learn how to learn. (*Reversed*)	.53	*.42*
When you first encounter a difficult concept in a textbook, it's best to work it out on your own.		
A sentence has little meaning unless you know the situation in which it is spoken. (*Reversed*)	.43	*.41*

Being a good student generally involves memorizing facts.				
Wisdom is not knowing the answers, but knowing how to find the answers. (*Reversed*)	.56			.*39*
Most words have one clear meaning.		.41		.*37*
Truth is unchanging.				
If a person forgot details, and yet was able to come up with new ideas from a text, I would think they were bright.				
Whenever I encounter a difficult problem in life, I consult with my parents.				
Learning definitions word for word is often necessary to do well on tests.				
When I study, I look for the specific facts.				
If a person can't understand something within a short amount of time, they should keep on trying. (*Reversed*)	.53			.*38*
Sometimes you just have to accept answers from a teacher even though you don't understand them.			.41	.*30*

If professors would stick more to the facts and do less theorizing, one could get more out of college.		.54	.*37*
I don't like movies that don't have an ending.			
Getting ahead takes a lot of work. (*Reversed*)	.48		.*33*
It's a waste of time to work on problems which have no possibility of coming out with a clear cut and unambiguous answer.		.43	.*37*
You should evaluate the accuracy of information in a textbook, if you are familiar with the topic. (*Reversed*)	.43		.*39*
Often, even advice from experts should be questioned.			
Some people are born good learners; others are just stuck with limited ability.			
Nothing is certain, but death and taxes.			
The really smart students don't have to work hard to do well in school.			

Working hard on a difficult problem for an extended period of time only pays off for really smart students.		.54	*.44*
If a person tries too hard to understand a problem, the will most likely just end up being confused.			
Almost all the information you can learn from a textbook you will get during the first reading.		.47	*.40*
Usually you can figure out difficult concepts if you eliminate all outside distractions and really concentrate. (*Reversed*)	.43		*.39*
A really good way to understand a textbook is to re organize the information according to your own personal scheme. (*Reversed*)	.43		*.32*
Students who are "average" in school will remain "average" for the rest of their lives.		.53	*.38*
A tidy mind is an empty mind.		-.40	*.33*
An expert is someone who has a special gift in some area.			
I really appreciate instructors who organize their lectures meticulously and then stick to their plan.			

The best thing about science courses is that most problems have only one right answer.				
Learning is a slow process of building up knowledge. (*Reversed*)	.49			*.36*
Today's facts may be tomorrow's fiction. (*Reversed*)	-.50			*.37*
Self help books are not much help.				
You will just get confused if you try to integrate new ideas in a textbook with knowledge you already have about a topic.		.41		*.42*

Item	Factor 1 Innate Ability to Acquire Knowledge	Factor 2 Simple Knowledge	Factor 3 Certain Knowledge	h^2
Eigenvalues	6.34	4.81	2.56	
Sum of Sq Loadings Following Rotation	5.32	3.52	3.61	
% Var Following Rotation	10.07	7.63	4.06	

Factor 1

Fourteen items loaded on Factor 1, representing a variety of subscales: two from *Learning is Quick*, one from *Knowledge is Certain*, one from *Don't Criticize Authority*, three from *Can't Learn to Learn*, one from *Seek Single Answers*, two from *Avoid Integration*, one from *Learn the First Time*, two from *Success is Unrelated to Hard Work*, and one item from *Concentrated Effort is a Waste of Time*. Three of the subsets: *Can't Learn how to Learn, Learn the First Time*, and *Success is Unrelated to Hard Work* loaded consistently with Schommer's. Despite the fact that several subsets were represented by the loading items, a general theme of innate ability and certain knowledge emerged. Therefore, the first factor was named *Innate Ability to Acquire Certain Knowledge*. Two of the loading items came from the Success is Unrelated to Hard Work subset: "Wisdom is not knowing the answers, but knowing how to find the answers" (reversed); and "Getting ahead takes a lot of work" (reversed). Other items can be considered from a hard work versus innate ability perspective, such as "If a person can't understand something within a short amount of time, they should keep on trying" (reversed), "The most successful people have discovered how to improve their ability to learn" (reversed), and "If I find the time to reread a textbook chapter, I get a lot more out of it the second time" (reversed). Other items may be viewed from a certainty of knowledge framework, such as "A sentence has little meaning unless you know the context in which it was spoken" (reversed). Reliability for Factor 1 was high, at .73.

Factor 2

Nine items loaded on Factor 2, representing six subsets: two items from *Learning is Quick*, two from *Don't Criticize Authority*, one from *Ability to Learn is Innate*, two

from *Seek Single Answers*, one from *Learn the First Time*, and one item from *Avoid Integration*. Though the loading subsets are diverse, an overall theme of *Simple Knowledge* can be gleaned from the items. Loading items included "Most words have one clear meaning", "For success in school, it's best not to ask too many questions", "You can believe almost everything you read", "Almost all the information you can learn from a textbook you will get during the first reading", and "You'll just get confused if you try to integrate new ideas in a textbook with knowledge you already have about a topic". Reliability for Factor 2 was moderate at .56.

Factor 3

Four items loaded on Factor 3: One item from Don't Criticize Authority, two from Avoid Ambiguity, and one from Seek Single Answers. The factor was named *Certain Knowledge*, as three of the four items consider knowledge from a factual perspective. For example, although the item "Sometimes you just have to accept answers from a teacher even though you don't understand" is considered representative of omniscient authority by Schommer, it could also be considered within the realm of certain knowledge, in that although one may not understand an answer, most information disseminated from teachers is grounded in fact; factual knowledge is certain, and therefore should be readily accepted. The two other items are obviously certain in nature: "If professors would stick more to the facts and do less theorizing, one could get more out of college", and "It's a waste of time to work on problems which have no possibility of coming out with a clear cut and unambiguous answer". The fourth loading item does not intuitively correspond with the other three: "Educators should know by now which is the best method, lectures or small group discussions". However, when considering the

item's original subset *Seek Single Answers*, it could in fact relate considerably with the factual and certain nature of this factor. Similar to Factor 2, the reliability for the emergent Factor 3 was moderate, at .53.

Epistemic belief inventory

Overall reliability for the EBI fared better than the SEQ, at .78 (N = 32) with individual scales ranging from .26 (simple knowledge) to .72 (innate ability). Like the SEQ, principal axis factoring was conducted on the EBI scales. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was .82 with Bartlett's Test of Sphericity [χ^2 (496) = 3077.037; p=.000], each considering factor analysis appropriate for the scale. Initial correlations were small to moderate, ranging from .00 to .49; as well as communalities, ranging from .15 to .46. Eight factors with eigenvalues greater than 1.00 were produced accounting for 54.43% of variance. Through parallel analysis, visual inspection of the scree plot (see Figures 3 and 4), and previous theory, four factors were retained accounting for 39.45% of variance. Following Promax rotation, eight of the 32 items did not significantly load on any factors and four items cross-loaded on two or more factors. As with the SEQ, oblique rotation was utilized, as theoretically, the emergent factors should be correlated. The factor correlation matrix indicated moderately correlated dimensions, ranging from .06 to -.41. Factor loading were also moderate, ranging from .32 to .64. Ten items loaded on Factor 1: six from the Innate Ability subscale, three from the Quick Learning subscale (two of the three items from this scale cross loaded on other factors) and one from the Certain Knowledge subscale (see Table 7). The four factors were named Innate Ability (λ= 5.10; 15.93 % of variance), Quick and Certain Knowledge

(λ= 3.18; 9.94% of variance), Simple Knowledge (λ=2.61; 8.14% of variance), and Source of Absolute Knowledge (λ= 1.74; 5.44% of variance).

Figure 3: EBI Scree Plot

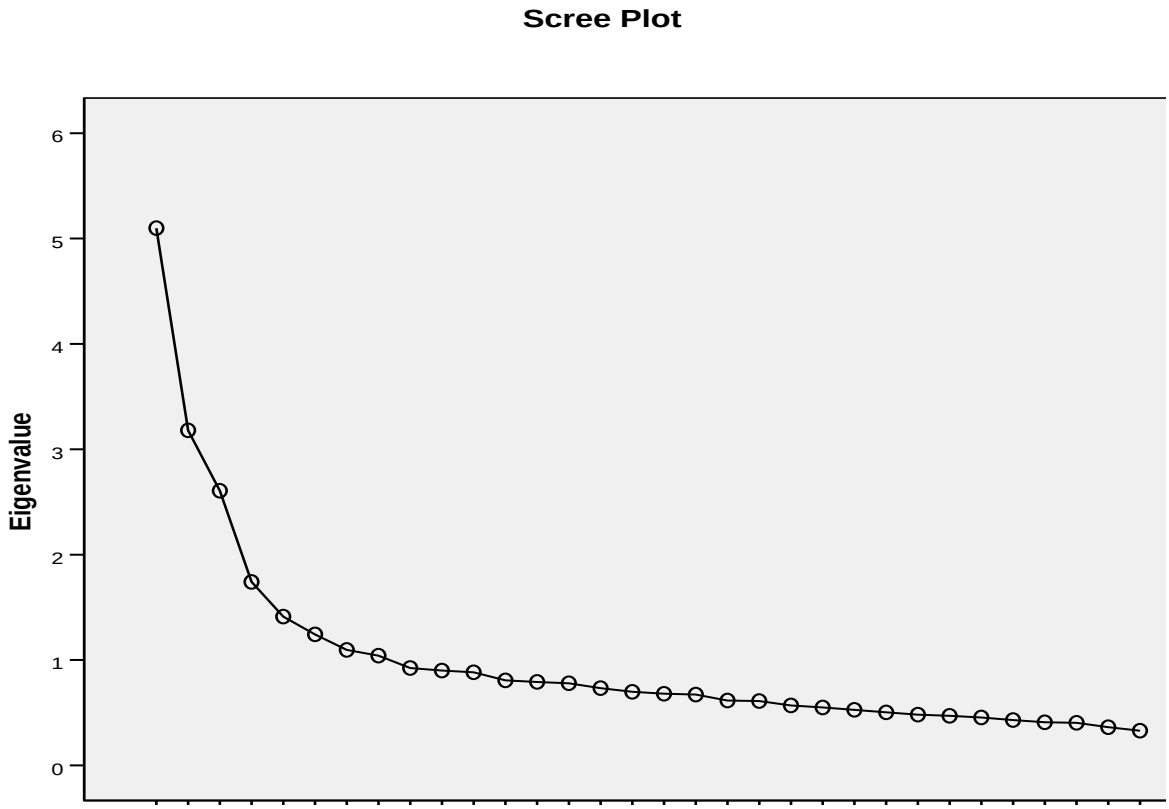

Figure 4: EBI Parallel Analysis

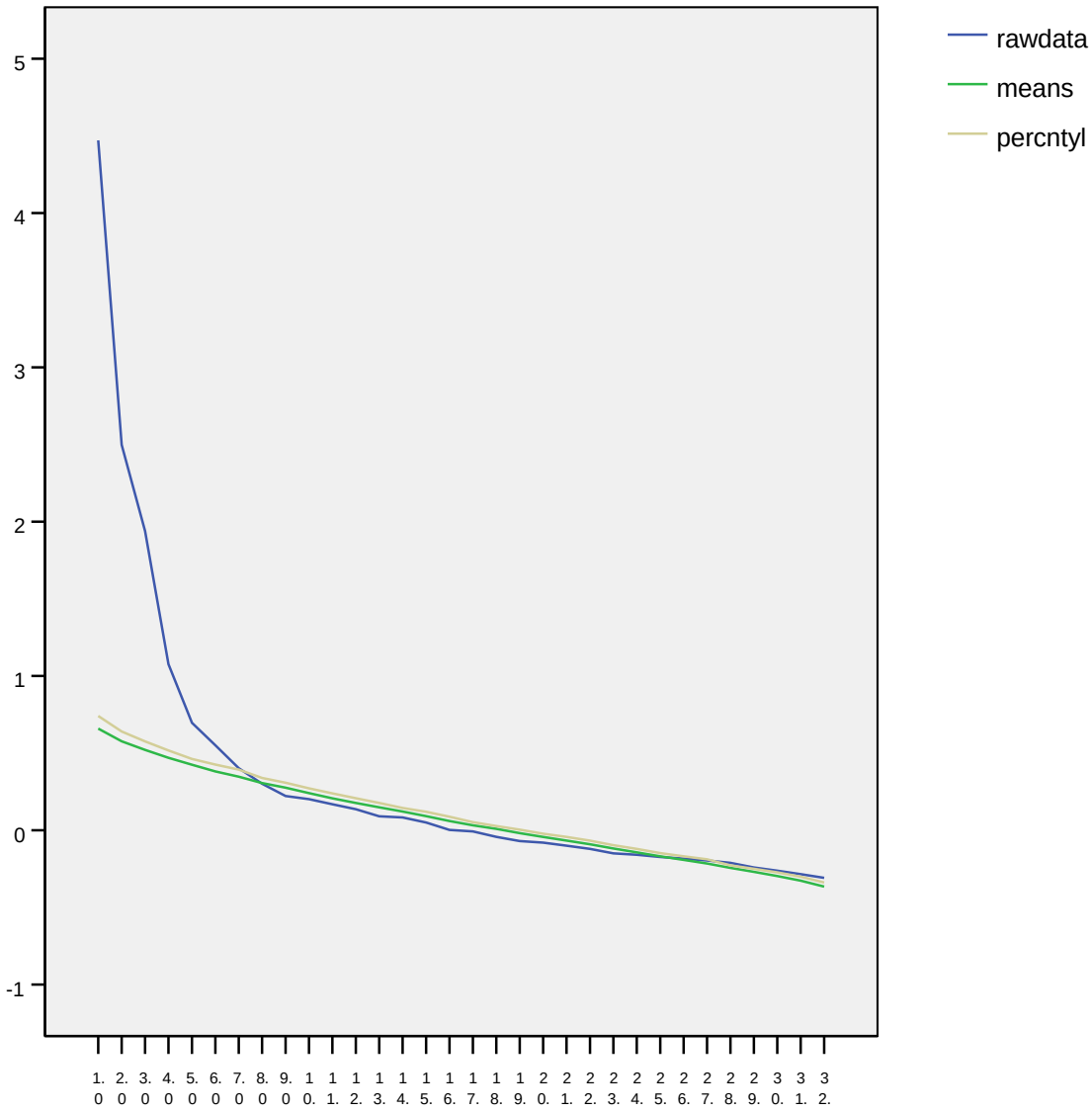

Table 7: Factor Loadings and Communalities (h^2) for the Epistemic belief inventory

Item	Factor 1 Innate Ability	Factor 2 Quick and Certain Knowledge.	Factor 3 Simple Knowledge	Factor 4 Source of Absolute Knowledge	*h*2
It bothers me when instructors don't tell students the answers to complicated problems.		-.43			.26
Truth means different things to different people. (*Reversed*)		.59			.37
Students who learn things quickly are the most successful.	.61				.39
People should always obey the law.				.65	.41
Some people will never be smart no matter how hard they work.	.64				.43
Absolute moral truth does not exist. (*Reversed*)				.47	.25
Parents should teach their children all there is to know about life.					

Really smart students don't have to work as hard to do well in school.	.56			.37
If a person tries too hard to understand a problem, they will most likely end up being confused.			.52	.29
Too many theories just complicate things.			.61	.39
The best ideas are often the most simple.		-.434		.24
People can't do too much about how smart they are.	.57			.35
Instructors should focus on facts instead of theories.			.59	.41
I like teachers who present several competing theories and let their students decide which is best.				
How well you do in school depends on how smart you are.	.61			.37

If you don't learn something quickly, you won't ever learn it.	.53	.55		.44
Some people just have a knack for learning and others don't.	.45			.32
Things are simpler than most professors would have you believe.			.52	.28
If two people are arguing about something, at least one of them must be wrong.	.42	.45		.37
Children should be allowed to question their parents' authority.				
If you haven't understood a chapter the first time through, going back over it won't help.	.47	.58		.43
Science is easy to understand because it contains so many facts.				
The moral rules I live by apply to everyone.				

The more you know about a topic, the more there is to know.					
What is true today will be true tomorrow.					
Smart people are born that way.	.64				.41
When someone in authority tells me what to do, I usually do it.				.43	.31
People who question authority are trouble makers.				.43	.34
Working on a problem with no quick solution is a waste of time.		.43	.62		.46
You can study something for years and still not really understand it.					
Sometimes there are no right answers to life's big problems. (Reversed)		.45			.28
Some people are born with special gifts and talents.		-.58			.33

Item	Factor 1 Innate Ability	Factor 2 Quick and Certain Knowledge.	Factor 3 Simple Knowledge	Factor 4 Source of Absolute Knowledge	*h*2
Eigenvalues	5.10	3.18	2.61	1.74	
Sum of Sq Loadings Following Rotation	3.86	3.22	2.86	2.06	
% Var Following Rotation	15.93	9.94	8.14	5.44	

Factor 1

The majority of items comprising factor one are from the innate ability (IA) subscale, which implies people are either born with a predisposition for learning and intelligence, or they aren't. The three loading items from the quick learning (QL) subscale lend support to the overall innate ability concept in this first factor, as they can easily be considered from an IA perspective. For instance, the QL item "If you haven't understood a chapter first time through, going back over it won't help" could also be considered IA in nature in that if you can't understand a chapter first time through, you probably don't have the innate ability to understand it; therefore, going back over it is futile. Similarly, the remaining QL items, "students who learn things quickly are the most successful" and "if you don't learn something quickly, you won't ever learn it" can also be considered within an IA framework in that if you don't learn something quickly, you probably don't have the innate ability to ever understand it and those with innate ability learn quickly and are therefore successful. The lone certain knowledge (CK) item "if two people are arguing about something, at least one of them must be wrong" follows in suit, in that if two people are arguing, one of them must not have the innate ability to understand the truth. For these reasons, factor one is named *Innate Ability*. Reliability for this factor was high, at .81.

Factor 2

Nine items comprise factor 2: two from the simple knowledge subscale (SK), three from CK, three from QL and one from IA. This factor was by far the most difficult to interpret as it is comprised with close to an equal amount of items from four subscales. However, the overall theme appeared to be knowledge is certain and acquisition should

be quick. Therefore, Factor 2 was accordingly named *Quick and Certain Knowledge*. The items supporting the quick aspect are fairly straightforward. Although "It bothers me when instructors don't tell students the answers to complicated problems" was considered Simple Knowledge by Schraw, it could be considered quick in nature, as one prefers a quick answer from the teacher. Three items also loaded from Schraw's Quick Learning scale: "If you don't learn something quickly, you won't ever learn it", "If you haven't understood a chapter the first time through, going back over it won't help", and "Working on a problem with no quick solution is a waste of time". With respect to the certainty aspect of this factor, all three items loading from Schraw's certain knowledge dimension emerged: "Truth means different things to different people" (reversed), "If two people are arguing about something, at least one of them must be wrong", and "Sometimes there are no right answers to life's big problems" (reversed). Reliability for this factor was lower than Factor 1, at .32.

Factor 3

Five items loaded on Factor 3: two from SK, one from CK, and two from QL. All items were interpreted to measure *Simple Knowledge*. As two of the items were from the SK subscale "Too many theories just complicate things", and "Things are simpler than most professors would have you believe", the remaining three also could be considered from a simple knowledge perspective. "Instructors should focus on facts rather than theories" (CK) could represent SK in that knowledge is simple; therefore facts adequately represent the truth. "Working on a problem with no quick solution is a waste of time" (QL) could be interpreted as given the view of knowledge is simple, most relevant solutions should be fairly quick. The same could be said for the remaining item: "If a

person tries too hard to understand a problem, they will most likely end up being confused". Reliability of Factor 3 was fairly high at .70.

Factor 4

Factor 4 was named *Source of Absolute Knowledge*. One item from the CK dimension loaded on this factor "Absolute moral truth does not exist" (reversed), while the remaining three loading items were from the Omniscient Authority scale. The items, "People should always obey the law", "When someone in authority tells me what to do, I usually do it", and "People who question authority are trouble makers" obviously speak to belief in an omniscient source of knowledge. The four items together in this last factor give a fairly clear picture of its overall premise. Reliability for Factor 4 was moderate, at .57.

Higher Order Factors

Factor scores from the SEQ and EBI were correlated to inspect the possibility of higher order factors across the two measures. Interestingly, the majority of correlations were low, as shown in Table 8:

Table 8: First Order Factor Score Correlations

		EBIF1	EBIF2	EBIF3	EBIF4	SEQF1	SEQF2	SEQF3
Correlation	EBIF1	1.00	.08	-.19	-.51	.04	.02	.33
	EBIF2	.08	1.00	.01	-.16	.00	.14	-.24
	EBIF3	-.19	.01	1.00	-.23	.29	.09	.01
	EBIF4	-.51	-.16	-.23	1.00	-.12	-.02	-.22
	SEQF1	.04	.00	.29	-.12	1.00	.02	-.31
	SEQF2	.02	.14	.09	-.02	.02	1.00	-.23
	SEQF3	.33	-.24	.01	-.22	-.31	-.23	1.00

Initial correlations were primarily low with the exception of EBI Factor 1 and EBI Factor 4 (-.51), EBI Factor 1 and SEQ Factor 3 (.33), and SEQ Factor 1 and SEQ Factor 3 (-.31). The KMO Measure of Sampling Adequacy for the factor scores was .399 and Bartlett's Test of Sphericity was not significant at [χ^2 (21) = 30.704; p=.08]. As correlations between the factor scores of the initial factors were primarily low and neither the KMO nor Barlett's tests indicated the presence of theoretically meaningful second order factors, the hierarchical factor analysis was abandoned with the conclusion that higher order factors do not exist across the two measures. As such, the first order factors scores from both the SEQ and EBI scales, along with the related constructs of motivation, learning strategy and implicit theories of intelligence were analyzed via multiple regression.

The Relationships among Factor Scores and Related Constructs

Utilizing multiple regression analysis, motivation and learning strategies subscales from the MSLQ, as well as scores from the TIS were individually regressed on a linear combination of the seven first order factor scores of the SEQ and EBI. Inspection of the residual plots for all three analyses showed a random variation of points around the horizontal line, lending support to the required assumptions for the model, and the minimum Cook's distance statistics were below 1.00, indicating no outliers. Initial correlations between factor scores and scores on the motivation subscale were small to moderate, ranging from .00 to -.51. The result of regressing motivation subscale scores on the linear combination of seven factor scores showed a statistically significant relationship [F(7,390) =27.57, p=.000] accounting for 33% of variance. Partial and semipartial correlations provide a means of assessing the relative "importance" of independent variables in determining the dependent variable; basically, they show how much

each variable uniquely contributes to R^2 over and above that which can be accounted for by the other independent variables. To that end, scores from SEQ Factor 1 (*Innate Ability to Acquire Certain Knowledge*), and scores from EBI Factor 1 (*Innate Ability*) appeared to be the most useful predictors of motivation scores (see Table 9). The regression coefficient (or beta coefficient) is also a helpful in interpreting results, by indicating the unique contribution of each variable. Higher scores on the EBI and SEQ represent an increasingly naïve epistemology. Therefore, it is not surprising to see the negative regression coefficient of EBI Factor 1, *Innate Ability*. This indicates a more naïve perspective of innate ability is negatively associated with higher motivation scores. The regression coefficient from SEQ Factor 1, *Innate Ability to Acquire Certain Knowledge* is positive; however, all of the items comprising this factor were reverse coded.

The result of regressing the learning strategies subscale on the seven factors showed a statistically significant relationship [$F(7,390) = 11.73$, $p = .000$] accounting for 17% of variance. Scores from SEQ Factor 1 (*Innate Ability to Acquire Certain Knowledge)* and EBI Factor 1 (*Innate Ability*) appear to be the greatest predictors for learning strategies, as evidenced in Table 10. As noted above, for both SEQ and EBI factor scores, more sophisticated epistemological beliefs are positively associated with scores on the learning strategies subscale. Both scales are written from a naïve perspective and SEQ items are reverse coded. The relationship between factor scores and TIS scores was not statistically significant, [$F(7,390) = 1.72$, $p = .10$]. This lack of association supports earlier findings that personal epistemological beliefs, as measured by the SEQ and EBI, are unrelated to Implicit Theories of Intelligence (Braten and Strømso , 2005).

Although results of the multiple regression analysis appear to lend support to previous findings, caution should be exercised while considering these outcomes. Supporting previous factor analytic analyses, neither the SEQ nor the EBI exhibited structural stability. It is entirely possible for subsequent studies to find diverse factor structures of both instruments, as well as varied regression results. Multiple regression analysis of first-order factors was included in this study simply due to the lack of a higher-order factor structure.

Table 9: Coefficient Table – Factor Scores and Motivation

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	Constant	146.59	.81		174.29	.00	144.94	148.25					
	EBIF1	-260.51	93.65	-11.97	-2.78	.01	-444.64	-76.39	-.54	-.14	-.12	.00	10787.17
	EBIF2	50.44	49.58	2.23	1.02	.31	-47.04	147.91	-.14	.05	.04	.00	2788.61
	EBIF3	-28.83	18.39	-1.24	-1.57	.12	-64.99	7.33	-.10	-.08	-.07	.00	362.10
	EBIF4	-6.61	16.72	-.28	-.40	.69	-39.48	26.26	-.09	-.02	-.02	.00	289.58
	SEQF1	206.36	81.87	9.47	2.52	.01	45.40	367.38	-.54	.13	.10	.00	8231.49
	SEQF2	77.58	35.57	3.42	2.18	.03	7.66	147.51	-.24	.11	.09	.00	1432.58
	SEQF3	-77.05	52.34	-3.33	-1.47	.14	-179.95	25.86	.04	-.07	-.06	.00	3060.80

Table 10: Coefficient Table – Factor Scores and Learning Strategies

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	Constant	133.34	.99		134.29	.00	131.39	135.30					
	EBIF1	-347.50	110.56	-15.02	-3.14	.00	-564.88	-130.13	-.37	-.16	-.145	.00	10787.17
	EBIF2	90.88	58.53	3.77	1.55	.12	-24.20	205.96	.01	.08	.071	.00	2788.61
	EBIF3	-23.49	21.71	-.95	-1.08	.28	-66.18	19.20	.04	-.06	-.050	.00	362.09
	EBIF4	-19.39	19.74	-.77	-.98	.33	-58.20	19.41	-.10	-.05	-.045	.00	289.58
	SEQF1	285.95	96.65	12.35	2.96	.00	95.92	475.98	-.37	.15	.136	.00	8231.49
	SEQF2	79.37	41.99	3.29	1.89	.060	-3.18	161.92	-.08	.09	.087	.00	1432.58
	SEQF3	-120.46	61.79	-4.96	-1.95	.05	-241.95	1.03	.13	-.09	-.090	.00	3060.80

CHAPTER V

DISCUSSION

The discussion of results and conclusions based on the findings of this study are presented with respect to each of the four research questions. The current inquiry was designed to determine the internal structures of the Schommer Epistemological Questionnaire and Epistemic belief inventory , and to explore their relationships with theoretically related constructs. Reliability analyses and structural dimensions of the SEQ and EBI are presented first to address the first two research questions, followed by discussion of the attempt to explore higher order factors between the two scales (research question three). To address research question four, the relationships between first order factors and related constructs are discussed, as a hierarchical factor structure was not determined between the SEQ and EBI. The discussion closes with study limitations, recommendations for future research, and conclusions.

Structure Analysis of the SEQ and EBI

Previous studies of the SEQ have typically produced three to five factors from the 63-item instrument. In the current study, a three factor oblique solution was retained, rotated by Promax with Kaiser Normalization. Of the 63 items analyzed, over half of the overall items (36) did not load on any factors at the .40 level. Although the reliability of the overall scale was moderate at .64, the factor structures reported by Schommer in previous inquiries were not replicated. A considerable array of subscales comprised each

factor, combining various dimensions, while items within only three of Schommer's 12item parcels loaded consistently with her analyses. This lack of consistency and large amount of non-loading items supports previous notions that the SEQ may not be the most psychometrically sound instrument with which to assess personal epistemological beliefs. The structure of the EBI appeared slightly more stable with reliability of .78, while eight of the 32 items did not load significantly on a factor. All five of the EBI's original dimensions emerged in the analysis, however, quick and certain knowledge were combined (Factor 2). Based on these results, though neither are ideal, the EBI may be a more psychometrically sound instrument than the SEQ.

Hierarchical Relationship between the SEQ and EBI

Research Question 3 sought to determine if a hierarchical dimension exists across both measures. However, the correlations among factors were small to moderate at best, and the KMO measure of sampling adequacy and Bartlett's test of sphericity did not support the presence of a higher order structure between the two scales. As higher order factors were not supported, multiple regression analyses were performed between first order factor scores and the constructs of motivation, learning strategy, and personal theories of intelligence, rather than second order factors as originally intended. Although a hierarchical structure did not emerge between the instruments, this finding in itself appears to be meaningful. Though both instruments are intended to measure comparable dimensions of personal epistemological beliefs, neither the SEQ nor the EBI produced first-order factors consistent with the authors' results, nor did the instruments share a common higher order factor to associate the two. This outcome is particularly surprising since individual items in both instruments are similarly worded (in some cases the

wording is identical). Because of this, one would expect at least some commonality between the two. These results lend support to the premise that the internal structure of each instrument is largely unknown, or sample specific, as consistent results have not materialized from any published inquiry to date.

Relationship between the SEQ, EBI, and Theoretically Related Constructs

As predicted, results from the multiple regression analysis suggest individuals with more naïve epistemological beliefs tend to less effectively utilize learning strategies such as elaboration, critical thinking, and organization strategies. Results from the regression analysis also lend support to the hypothesis that individuals with naïve beliefs exhibit less internal motivation for persistence and academic success. Supporting previous research and the hypothesis proposed in the current study, participants' implicit theories of intelligence scores were not statistically related to the epistemological dimension of intelligence. If a psychometrically sound instrument could be produced to replicate these findings, these outcomes could be noteworthy relationships to explore in future research. However, due to the questionable structure of both the SEQ and EBI, these results should be viewed with extreme caution.

Discussion

Given their lackluster histories with regard to structure and stability, it is surprising the SEQ and EBI have been utilized so readily in behavioral research. The small number of items in both measurements which load on factors consistent with Schommer and Schraw's theoretical structures; or for that matter, the small number of items that load on any factors at all, should be carefully considered before utilizing either instrument to assess personal epistemological beliefs. In the current analyses of the SEQ

and EBI, a considerable amount of scale items failed to load on any factor. Of the items which did load on the emergent factors, the small amount of accounted variance basically negates any findings of significance. For the SEQ, the three extracted factors accounted for a mere 21.78% of variance. This means 78.22% of the variance accounted for is due to error, or to variance unrelated to the construct of interest. This should give one pause to consider whether the instrument is measuring something other than what was intended, or if it is so poorly structured nothing of significance is truly being measured at all. The EBI shows greater promise, with four extracted factors accounting for 39.45% of variance. However, the remaining 60.55% of variance is again, due to error or variance unrelated to personal epistemological beliefs. But even as it is strikingly evident the two measurements of interest do not reliably capture a valid appraisal of personal epistemological beliefs, the appeal of using such instruments in attempt to quantify this construct is understandable. Self-report measures are efficient and user-friendly vehicles with which to gain information, while their quantitative natures also make statistical analyses possible. As referenced in Chapter 2, early qualitative attempts support the conception that students' beliefs of knowledge are associated with academic outcomes. It naturally follows then, that researchers would desire to validate these findings with reliable quantitative measures to support, and expand this line of inquiry. However, continued use of these popular instruments is not advisable. To truly garner confidence in research produced by means of the SEQ and EBI, their items are in clear need of revision. Although both instruments have been factor analyzed extensively, no two studies have revealed the exact same factor structures, even those conducted by the authors themselves. Rather than deleting items from the instruments, as many

researchers have done in attempt to produce a more psychometrically sound measure, it may prove more fruitful to modify the wording of the individual scale items. Many researchers have called the phrasing of current items into question. Items such as "a tidy mind is an empty mind" and "I don't like movies that don't have an ending" are ambiguous, while items such as "the most important aspect of scientific work is precise measurements and careful work" and "the best thing about science courses is that most problems have only one right answer" introduce domain-specific features to the predominately domain-general scales. This blending of items feeds into to the theoretical dispute of domain generality versus specificity: Are epistemic beliefs domain-general or domain-specific? If beliefs are domain-specific, do differences exist between hard and soft academic fields? Items included in the SEQ and EBI run the gamut as far as domain is concerned, and domain generality and specificity are obviously confounded with the inclusion of these contrasting questions. Also at play may be the fact that many items can be considered from competing dimensions. As referenced in the results section, results of principal axis factoring for both the SEQ and EBI led to many re-interpretations of the intended dimension of the original scale items. For instance, many items that were considered from the certain and quick subscales by Schommer and Schraw could actually be considered from a simple knowledge aspect. This may contribute to the confusion surrounding the number and nature of dimensions represented by personal epistemology. For these reasons, and supported by the large amount of non-loading scale items from both instruments, overhauling item wording may be one step in the right direction to produce a more grounded and reliable quantitative measure.

Beyond psychometric considerations, the theoretical foundation of personal epistemology is also in obvious need of revision. We cannot really criticize Schommer, Schraw, and their colleagues for creating such psychometrically poor instruments with which to measure epistemic beliefs. Without any consensus of a theoretical foundation to speak of, how can we expect the ensuing instruments to accurately assess what has yet to even be fully explained? Perhaps by altering the model, the construct can be operationalized more effectively. Conceivably, going back to the beginning of the study of personal epistemology could help direct where to go from here. Perry's initial works were from a developmental perspective. Perry, King and Kitchener, and others, found epistemic beliefs develop and mature in a fairly predictable way. Rather than debating the dimensionality of the construct, perhaps researchers should first take a step back and reinvestigate the progression of beliefs from a developmental perspective, and seek to operationalize this aspect accordingly. Many of the inquiries which attempt to link personal epistemological beliefs with potentially related constructs such as motivation, learning strategies, etc., tend to study the developmental association between the two. For instance, a common examination is the relationship between epistemic beliefs and achievement: as personal epistemological beliefs mature, does academic achievement increase? Other lines of inquiry consider mature epistemic beliefs and perseverance: as beliefs mature, do students' perceptions of self-perseverance increase? These inquiries all share one common premise: how do peripheral constructs progress in relation to the development and ascension of personal epistemological beliefs? Given the interest lies in determining the progression of both sets of constructs as they correspond to one other, it

may be worthwhile to take a look at the roots of personal epistemological beliefs with a developmental perspective.

As some research (albeit mostly qualitative) has supported a developmental framework by determining epistemic beliefs mature in a relatively predictable way, it naturally follows then that this result may have important bearing on the aforementioned studies. If the idea is to determine how epistemic and peripheral beliefs ascend together, the predictable progression of epistemic beliefs from a developmental perspective should prove useful. Some studies have shown personal epistemological beliefs mature as a function of education level; even those intended to assess domain. For instance, in their study of undergraduate and graduate students, Jehng et al. (1993) found students in hard academic domains (engineering, business, etc.) held more naïve beliefs in the source and certainty of knowledge dimensions than students in soft academic domains (humanities, social sciences, etc.). However, these perceived differences were attributed to distinction in academic classification. Specifically, no discrepancies were found between lower and upper-class undergraduate students, but, distinctions were found between undergraduate and graduate students. In their study of first through fifth year psychology and medical students, Lonka and Lindblom-Ylänne (1996) found novice medical students held the highest degree of dualism beliefs, followed by advanced medical students. Advanced psychology students had the lowest dualism score, followed by novice psychology students. Based on these results, the authors concluded that both domain and level of study are pertinent considerations in the study of personal epistemological beliefs. The two academic groups of students obviously differed in their dualistic or relativistic approaches to knowledge; hence, domain-specificity was supported. Also at play across

both groups however, was an obvious developmental trend toward more relativistic conceptions of knowledge. Even as domain-specificity was supported due to the higher degree of dualist beliefs within both medical student groups, it is important to note that *all* groups demonstrated a developmental trend to more sophisticated beliefs. In their study of college seniors and graduate students, King, Wood, and Mines (1990) utilized analysis of variance to determine educational level was of significance when investigating the progression of epistemic beliefs, even while controlling for academic aptitude. Finally, in their 1990 study, King et al. also found no difference in epistemic beliefs between undergraduate math and social science majors, but did find disparity between graduate math and social sciences majors, with all groups exhibiting more sophisticated beliefs at the graduate level. In addition to separations by domain, students in all the aforementioned studies exhibited a developmental trend toward more sophisticated epistemological beliefs, with a distinction between undergraduate and graduate groups. All of these studies support an important foundational premise: domain and level of education are important considerations when investigating personal epistemological beliefs.

In sum, if previous studies have found epistemic beliefs develop and mature predictably, while others have determined epistemic beliefs mature as a function of domain and level of education, this should give some insight as to where to start the renovation of a theoretical formation. However, to be truly comprehensive in the consideration of personal epistemological beliefs, one final aspect must be included when reconstructing a theoretical foundation: With so many dimensions failing to load or loading inconsistently in all published analyses to date, the dimensionality of personal

epistemological beliefs must also be re-evaluated. Clearly, one comprehensive instrument designed to measure epistemic beliefs is not working. With the notions of knowledge, knowing, and learning so intimately entwined, the attempt to assess all simultaneously is quite reasonable. But research does not support this blending of concepts. Several studies have supported the premise that those concepts *related* to knowledge may be in need of reconsideration. Specifically, the source of knowledge has yet to consistently emerge in any published factor analytic study to date. Although the current study supports previous findings that beliefs in the source of knowledge are separate from implicit theories of intelligence, this result doesn't necessarily support the inclusion of source of knowledge as a facet of personal epistemological beliefs. In addition, though conceptually the inclusion of speed of knowledge acquisition is reasonable, if scale item renovation does not consistently produce this dimension as a stable factor in factor analytic analyses, it may prove worthwhile to eliminate it from the definition of epistemic beliefs.

Based on the available literature base and results of the current study of personal epistemology, the reconsideration of this construct may benefit from the following suggestions:

1. Re-examine the progression of personal epistemological beliefs from a developmental perspective.
2. Clearly rephrase scale items of the SEQ and EBI in attempt to better capture the intended dimensions, and to reflect general or specific domains separately.
3. Following individual item reconstruction, eliminate dimensions that do not consistently emerge in statistical analyses.

Although these suggestions are certainly not a cure-all for the various concerns impeding the advancement of personal epistemology study, they may help re-orient scholars to expand this line of inquiry. The foundation and structure of personal epistemological beliefs are in need of refinement. Taking a step back in the abovementioned areas may assist in the grounding of this important construct.

Limitations

The current study was conducted at one Midwestern university and was completed by those who chose to participate for extra credit in a given psychology course and therefore, non-random. The sample contained little age, gender, or ethnic variation, with the majority of respondents between the ages of 20-22, female, and Caucasian. For these reasons, the results of the current study should be viewed with caution. Though promising, the results of this study are not fully generalizable to other populations.

Implications for Further Research

With respect to the SEQ and EBI, previous inquiries have reported poorly structured scales within both instruments, as well as a poorly defined construct of interest. Both scales were designed with the intent to measure personal epistemological beliefs, defined by naïve versus sophisticated beliefs of knowledge. In the current inquiry both instruments proved multi-dimensional; producing three and four first order factors via Principal Axis Factoring. Purported dimensions did not all emerge, nor did a hierarchical relationship between the two measures. However, although the current study primarily upholds previous concerns of the structure and stability of the SEQ and EBI scales, directions for future inquiry were also revealed. Factor 1 of the SEQ and Factor 1 of the EBI, both of which tap into the concept of innate ability to acquire knowledge,

portrayed the greatest reliability of all the resulting factors, at .73 and .81 respectively. These factors also had the largest amount of item loadings. Results of the multiple regression analysis suggest motivation is the primary external construct associated with both factors. Given these results, the primary constructs worth additional consideration with respect to quantitative analysis of personal epistemological beliefs appear to be the relationship between belief in innate ability and internal motivation. Additionally, re-wording of individual items may also prove a valuable extension of inquiry, as well as the considerations of domain and development. One thing we can be fairly sure about is that individuals' beliefs mature as a function of education level and conceivably, age. Going back to the drawing board armed with the little bit that we do know about personal epistemology may help guide us to what we don't know. It is with great hope that these results may help propel the conviction that before we can go forward, it is necessary to first take a step back.

Conclusion

This study was designed to assess the structural dimensions of two prominently utilized measurements of personal epistemological beliefs: the Schommer Epistemological Questionnaire and the Epistemic belief inventory , and to determine if a hierarchical relationship exists between the two measures. The study was also conducted to examine the relationship between personal epistemological beliefs and theoretically related constructs. Although many studies have utilized factor analytic and similar methods in attempt to unearth the true nature of the construct, their results strongly indicate the current structure of personal epistemology is undeterminable at this point. The aim of this study was to provide a "last-ditch effort" to examine the construct in its

current form, as measured by the SEQ and EBI. The hope was to definitively determine the structure through higher-order factor analysis. However, the underlying structures of the two instruments did not yield a higher-order factor, supporting previous concerns that it is unclear what the two instruments truly measure. Although the EBI was designed as a concise version of the SEQ, there is no statistical commonality between the two. Both instruments produced similar first factors, both representing belief in innate ability. The fact that these factors are composed of items from multiple subscales is worth noting. Although it would be somewhat premature to conclude the construct of personal epistemological beliefs is unidimensional, the concept of innate ability is present in the majority of items constructing each scale, and therefore the primary contributor to personal epistemological beliefs, at least as measured by the SEQ and EBI scales in this inquiry. The belief in innate ability is negatively associated with internal motivation, as evidenced by multiple regression. However, these findings cannot be considered definitive, as they are based on scores from the SEQ and EBI. Based on the instruments' histories, it is doubtful such results are replicable in other samples.

The Schommer Epistemological Questionnaire and Epistemic belief inventory have been utilized extensively by researchers from multiple academic disciplines. However, inclusion of these instruments is not advisable. The construct of personal epistemology may theoretically exist. But, it cannot conceptually exist in its current state of ambiguity and overwhelmingly weak structure. Until the theoretical foundation of personal epistemological beliefs can be more adequately defined, neither the SEQ nor EBI should be utilized for results to be valid or generalizable. Perhaps the best approach to continue the inquiry of personal epistemology is to recognize its current definition and

instruments are not working. For this concept to emerge as a genuinely significant contributor to the study of knowledge, significant changes are warranted. It should be noted, the conclusions of the current study are not intended to definitively solve the psychometric problems of the SEQ and EBI, nor do they propose a more dependable definition of personal epistemology. It is with great hope, however, that the current inquiry may aid in the advancement of the study of personal epistemology by offering recommendation as to where to go from here in the examination of this important phenomenon.

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APPENDICES

APPENDIX A

DEMOGRAPHIC SHEET AND INFORMED CONSENT

Please complete the following items:

1. What is your age?
   ___ 20-22
   ___ 23-25
   ___ 26-28
   ___ 29-31
   ___ 32-34
   ___ 35-37
   ___ 38-40
   ___ >40

2. What is your gender?
   ___ Male
   ___ Female

3. Please check the item that best describes your ethnicity:
   ___ African American
   ___ Asian
   ___ Caucasian
   ___ Hispanic/Latino(a)
   ___ Native American
   ___ Other

4. What year are you?
   ___ Freshman
   ___ Sophomore
   ___ Junior
   ___ Senior

INFORMED CONSENT DOCUMENT

Project Title: An Internal Structure Assessment of Measurements of Personal Epistemological Beliefs: A Second Order Factor Analysis

Principal Investigator:

Bonnie Bost Laster, M.S.
Oklahoma State University

Purpose:

The purpose of this research study is to examine the psychometric properties and internal structure of two instruments designed to measure personal epistemological beliefs: the Schommer Epistemological Questionnaire (SEQ) and Epistemic Belief Inventory (EBI). In order to fully explore the qualities of these instruments it is necessary to have them completed. Therefore, students are being asked to complete the two instruments, plus two additional measurements as correlates: two scales from the Motivated Strategies for Learning Questionnaire (MSLQ) and the Implicit Theory of Intelligence Scale.

Procedures and Consent:

Participants will complete each instrument on-line at their convenience through SONA. Participants are expected to work independently. To ensure confidentiality, names, student identification numbers, or any other kind of personal identification will not be requested or accepted. Each student will be assigned a random participation number through the SONA system which cannot be traced to the participant. Participants will be asked to complete a short demographic sheet, regarding age, year of school, gender, etc. However, the demographic sheet will not be used for identification purposes. No discomfort or inconvenience of the subjects is anticipated. Participation is purely voluntary and will take place at the participants' discretion. As this research study is entirely electronic, no written consent will be collected. Completion of the entire research study will constitute participants' consent to participate. Participants finish each instrument by clicking "next" after the completion of each electronic page. Participants may electronically close out of the on-line instruments any time should they choose to not complete the research study. There are no penalties for withdrawal from the research study.

Risks of Participation:

There are no known risks associated with this project which are greater than those ordinarily encountered in daily life.

Benefits:

While participants are unlikely to directly benefit from the research study,

society in general may benefit from the current inquiry. A better understanding of personal epistemology may prove beneficial in the applied academic environment. Multiple studies have indicated students' beliefs affect their academic performance. A thorough understanding of the true nature of epistemological beliefs may impart educators with the knowledge to encourage effective learning or adapt our instructional systems to correspond with students' needs. However, perhaps most importantly, the research study of personal epistemology may allow educators to empower the student to engage in her or her own creative and critical thinking, thus creating a more informed citizenry.

Confidentiality:

Subject data will remain anonymous throughout the duration of the research study. Full names, identification numbers, birth dates or any other identifying aspects of the subjects will not be included. All data will be collected in a manner in which the subjects' data will be anonymous even to the PI through the SONA system. Consent forms will include the participant number only, which is not traceable to the participant. All research study data will be compiled into the P.I.'s private computer randomly. Only the P.I. will have access to stored data. The data will be utilized to perform statistical analysis via SPSS. All paper data will be destroyed within one year. There are no foreseeable risks to maintaining confidentiality for the duration of this research study. **The OSU IRB has the authority to inspect consent records and data files to assure compliance with approved procedures**.

Compensation:

Students may participate in this research study to earn extra credit through the Psychology Department. Most instructors of lower division psychology courses offer extra credit for participation in current research studies. Participation in this research study should take approximately one hour and will qualify for 1 unit of SONA credit. Alternatives for extra credit in these courses are also available. Please refer to your instructor for full details.

Contacts: The Principal Investigator for this research study is Bonnie Bost Laster, M.S., doctoral student at Oklahoma State University, 918-231-8622, bonnie.laster@okstate.edu.

If you have questions about your rights as a research volunteer, you may contact Dr. Shelia Kennison, IRB Chair, 219 Cordell North, Stillwater, OK 74078, 405-744-1676 or irb@okstate.edu.

Participant Rights:

Participation in this research study is voluntary and subjects can discontinue the

research activity at any time without reprisal or penalty. There are no risks to subjects for withdrawal.

APPENDIX B

Schommer Epistemological Questionnaire

Directions: There are no right or wrong answers for the following questions. We want to know what you really believe. For each statement fill in the circle on the answer sheet for the degree to which you agree or disagree.

Strongly Disagree				Strongly Agree
1	2	3	4	5

1. If you are ever going to be able to understand something, it will make sense to you the firs time you hear it.

2. The only thing that is certain is uncertainty itself.

3. For success in school, it's best not to ask too many questions.

4. A course in study skills would probably be valuable.

5. How much a person gets out of school mostly depends on the quality of the teacher.

6. You can believe almost everything you read

7. I often wonder how much my teachers really know.

8. The ability to learn is innate.

9. It is annoying to listen to a lecturer who cannot seem to make up his mind as to what he really believes.

10. Successful students understand things quickly.

11. A good teacher's job is to keep his students from wandering from the right track.

12. If scientists try hard enough, they can find the truth to almost anything.

13. People who challenge authority are over-confident.

14. I try my best to combine information across chapters or even across classes.

15. The most successful people have discovered how to improve their ability to learn.

16. Things are simpler than most professors would have you believe.

17. The most important aspect of scientific work is precise measurement and careful work.

18. To me studying means getting the big ideas from the text, rather than details.

19. Educators should know by now which is the best method, lectures or small group discussions.

20. Going over and over a difficult textbook chapter usually won't help you understand it.

21. Scientists can ultimately get to the truth.

22. You never know what a book means unless you know the intent of the author.

23. The most important part of scientific work is original thinking.

24. If I find the time to re-read a textbook chapter, I get a lot more out of it the second time.

25. Students have a lot of control over how much they can get out of a textbook.

26. Genius is 10% ability and 90% hard work.

27. I find it refreshing to think about issues that authorities can't agree on.

28. Everyone needs to learn how to learn.

29. When you first encounter a difficult concept in a textbook, it's best to work it out on your own.

30. A sentence has little meaning unless you know the situation in which it is spoken.

31. Being a good student generally involves memorizing facts.

32. Wisdom is not knowing the answers, but knowing how to find the answers.

33. Most words have one clear meaning.

34. Truth is unchanging.

35. If a person forgot details, and yet was able to come up with new ideas from a text, I would think they were bright.

36. Whenever I encounter a difficult problem in life, I consult with my parents.

37. Learning definitions word-for-word is often necessary to do well on tests.

38. When I study, I look for the specific facts.

39. If a person can't understand something within a short amount of time, they should keep on trying.

40. Sometimes you just have to accept answers from a teacher even though you don't understand them.

41. If professors would stick more to the facts and do less theorizing, one could get more out of college.

42. I don't like movies that don't have an ending.

43. Getting ahead takes a lot of work.

44. It's a waste of time to work on problems which have no possibility of coming out with a clear-cut and unambiguous answer.

45. You should evaluate the accuracy of information in a textbook, if you are familiar with the topic.

46. Often, even advice from experts should be questioned.

47. Some people are born good learners, others are just stuck with limited ability.

48. Nothing is certain, but death and taxes.

49. The really smart students don't have to work hard to do well in school.

50. Working hard on a difficult problem for an extended period of time only pays off for really smart students.

51. If a person tries too hard to understand a problem, the will most likely just end up being confused.

52. Almost all the information you can learn from a textbook you will get during the first reading.

53. Usually you can figure out difficult concepts if you eliminate all outside distractions and really concentrate.

54. A really good way to understand a textbook is to re-organize the information according to your own personal scheme.

55. Students who are "average" in school will remain "average" for the rest of their lives.

56. A tidy mind is an empty mind.

57. An expert is someone who has a special gift in some area.

58. I really appreciate instructors who organize their lectures meticulously and then stick to their plan.

59. The best thing about science courses is that most problems have only one right answer.

60. Learning is a slow process of building up knowledge.

61. Today's facts may be tomorrow's fiction.

62. Self-help books are not much help.

63. You will just get confused if you try to integrate new ideas in a textbook with knowledge you already have about a topic.

APPENDIX C

Epistemic belief inventory

Please indicate how strongly you agree or disagree with each of the statements listed below. Please select the number that best corresponds to the strength of your belief.

Strongly Disagree 1 2 3 4 5 Strongly Agree

1. It bothers me when instructors don't tell students the answers to complicated problems.

2. Truth means different things to different people.

3. Students who learn things quickly are the most successful.

4. People should always obey the law.

5. Some people will never be smart no matter how hard they work.

6. Absolute moral truth does not exist.

7. Parents should teach their children all there is to know about life.

8. Really smart students don't have to work as hard to do well in school.

9. If a person tries too hard to understand a problem, they will most likely end up being confused.

10. Too many theories just complicate things.

11. The best ideas are often the most simple.

12. People can't do too much about how smart they are.

13. Instructors should focus on facts instead of theories.

14. I like teachers who present several competing theories and let their students decide which is best.

15. How well you do in school depends on how smart you are.
16. If you don't learn something quickly, you won't ever learn it.
17. Some people just have a knack for learning and others don't.
18. Things are simpler than most professors would have you believe.
19. If two people are arguing about something, at least one of them must be wrong.
20. Children should be allowed to question their parents' authority.
21. If you haven't understood a chapter the first time through, going back over it won't help.
22. Science is easy to understand because it contains so many facts.
23. The moral rules I live by apply to everyone.
24. The more you know about a topic, the more there is to know.
25. What is true today will be true tomorrow.
26. Smart people are born that way.
27. When someone in authority tells me what to do, I usually do it.
28. People who question authority are trouble makers.
29. Working on a problem with no quick solution is a waste of time.
30. You can study something for years and still not really understand it.
31. Sometimes there are no right answers to life's big problems.
32. Some people are born with special gifts and talents.

Appendix D
Adapted Motivated Strategies for Learning Questionnaire*

Please rate the following items based on your behavior in most classes. Your rating should be on a 7- point scale where **1= not at all true of me** to **7=very true of me**

1. In most courses, I prefer course material that really challenges me so I can learn new things.
2. If I study in appropriate ways, then I will be able to learn the material in most courses.
3. When I take a test I think about how poorly I am doing compared with other students.
4. I think I will be able to use what I learn in most courses in other courses.
5. I believe I will receive an excellent grade in most classes.
6. I'm certain I can understand the most difficult material presented in the readings for most courses.
7. Getting a good grade in most classes is the most satisfying thing for me right now.
8. When I take a test I think about items on other parts of the test I can't answer.
9. It is my own fault if I don't learn the material in most courses.
10. It is important for me to learn the course material in most classes.
11. The most important thing for me right now is improving my overall grade point average, so my main concern in most classes is getting a good grade.
12. I'm confident I can learn the basic concepts taught in most courses.
13. If I can, I want to get better grades in most classes than most of the other students.
14. When I take tests I think of the consequences of failing.
15. I'm confident I can understand the most complex material presented by the instructor in most courses.
16. In most classes, I prefer course material that arouses my curiosity, even if it is difficult to learn.
17. I am very interested in the content area of most courses.
18. If I try hard enough, then I will understand the course material.
19. I have an uneasy, upset feeling when I take an exam.
20. I'm confident I can do an excellent job on the assignments and tests in most courses.
21. I expect to do well in most classes.
22. The most satisfying thing for me in most courses is trying to understand the content as thoroughly as possible.
23. I think the course material in most classes is useful for me to learn.

24. When I have the opportunity in most classes, I choose course assignments that I can learn from even if they don't guarantee a good grade.
25. If I don't understand the course material, it is because I didn't try hard enough.
26. I like the subject matter of most courses.
27. Understanding the subject matter of most courses is very important to me.
28. I feel my heart beating fast when I take an exam.
29. I'm certain I can master the skills being taught in most classes.
30. I want to do well in most classes because it is important to show my ability to my family, friends, employer, or others.
31. Considering the difficulty of most courses, the teachers, and my skills, I think I will do well in most classes.
32. When I study the readings for most courses, I outline the material to help me organize my thoughts.
33. During class time I often miss important points because I'm thinking of other things.
34. When reading for most courses, I make up questions to help focus my reading.
35. I often find myself questioning things I hear or read in most courses to decide if I find them convincing.
36. When I study for most classes, I practice saying the material to myself over and over.
37. When I become confused about something I'm reading for most classes, I go back and try to figure it out.
38. When I study for most courses, I go through the readings and my class notes and try to find the most important ideas.
39. If course readings are difficult to understand, I change the way I read the material.
40. When studying for most courses, I read my class notes and the course readings over and over again.
41. When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.
42. I make simple charts, diagrams, or tables to help me organize course material.
43. I treat the course material as a starting point and try to develop my own ideas about it.
44. When I study for most classes, I pull together information from different sources, such as lectures, readings, and discussions.
45. Before I study new course material thoroughly, I often skim it to see how it is organized.
46. In most classes I ask myself questions to make sure I understand the material I have been studying.
47. I try to change the way I study in order to fit the course requirements and the instructor's teaching style.
48. I often find that I have been reading for a class but don't know what it was all about.
49. I memorize key words to remind me of important concepts in most classes.

50. I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for most courses.
51. I try to relate ideas in subjects to those in other courses whenever possible.
52. When I study for most courses, I go over my class notes and make an outline of important concepts.
53. When reading for most classes, I try to relate the material to what I already know.
54. I try to play around with ideas of my own related to what I am learning in most courses.
55. When I study for most courses, I write brief summaries of the main ideas from the readings and my class notes.
56. I try to understand the material in most classes by making connections between the readings and the concepts from the lectures.
57. Whenever I read or hear an assertion or conclusion in most classes, I think about possible alternatives.
58. I make lists of important items for most courses and memorize the lists.
59. When studying for most courses I try to determine which concepts I don't understand very well.
60. When I study for most classes, I set goals for myself in order to direct my activities in each study period.
61. If I get confused taking notes in class, I make sure I sort it out afterwards.
62. I try to apply ideas from course readings in other class activities such as lecture and discussion.

* Adapted from Pintrich, R. R., & DeGroot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance, *Journal of Educational Psychology, 82*, 33-40.

Items which originally indicated "in this course" or "in this class" have been changed to "in most courses" or "in most classes".

APPENDIX E

Implicit Theories of Intelligence Scale

Disagree Strongly				Agree Strongly	
1	2	3	4	5	6

1. You have a certain amount of intelligence and you can't really do much to change it.
2. Your intelligence is something about you that can't change very much.
3. No matter who you are, you can significantly change your intelligence level.
4. To be honest, you can't really change how intelligent you are.
5. You can always substantially change how intelligent you are.
6. You can learn new things, but you can't really change your basic intelligence.
7. No matter how much intelligence you have, you can always change it quite a bit.
8. You can change even your basic intelligence level considerably.

APPENDIX F

IRB APPROVAL FORM

Oklahoma State University Institutional Review Board

Date:	Tuesday, January 13, 2009
IRB Application No	ED08169
Proposal Title:	An Internal Structure Assessment of Measurements of Personal Epistemological Beliefs: A Second Order Factor Analysis
Reviewed and Processed as:	Expedited

Status Recommended by Reviewer(s): Approved **Protocol Expires: 1/12/2010**

Principal Investigator(s):

Bonnie Laster
8802 Creekstone Road
Waxhaw, NC 28173

Dale Fuqua
444 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.

[X] 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,

Sheila Kennison, Chair
Institutional Review Board

VITA

Bonnie Bost Laster

Candidate for the Degree of

Doctor of Philosophy

Thesis: A STRUCTURAL AND CORRELATIONAL ANALYSIS OF TWO COMMON MEASURES OF PERSONAL EPISTEMOLOGY

Major Field: Educational Psychology: Research and Evaluation

Biographical:

Education: Graduated from Edison Senior High School, Tulsa, OK in 1990; attended Oklahoma State University, Stillwater OK from 1990 to 1992; graduated with a B.S. degree in Community Health Education from the University of Kansas, Lawrence KS in 1995; graduated with an M.S. degree in Applied Behavioral Studies from Oklahoma State University, Stillwater OK in 2004; Completed the requirements for the Doctor of Philosophy degree with a major in Educational Psychology and emphasis in Research and Evaluation at Oklahoma State University, Stillwater, Oklahoma in December, 2010.

Experience: Regional Director of the American Heart Association, Tulsa, OK 1995 to 1997; Diabetes Education Coordinator for Tulsa Regional Medical Center, Tulsa, OK 1998 to 1999; Associate Director of Admission and Recruitment for Oklahoma State University Center for Health Sciences, Tulsa, OK 1999 to 2005; Federal Program Evaluator, United Way of Ponca City, Tulsa, OK 2003 to 2009; Lead Evaluator, The Evaluation Group, Charlotte, NC January 2010 to present

Professional Memberships: AEA

Name: Bonnie Bost Laster Date of Degree: December, 2010

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: A STRUCTURAL AND CORRELATIONAL ANALYSIS OF TWO COMMON MEASURES OF PERSONAL EPISTEMOLOGY

Pages in Study: 115 Candidate for the Degree of Doctor of Philosophy

Major Field: Educational Psychology; Research and Evaluation

Scope and Method of Study: The current inquiry is a factor analytic study which utilizes first and second order factor analytic methods to examine the internal structures of two measurements of personal epistemological beliefs: the Schommer Epistemological Questionnaire (SEQ) and Epistemic Belief Inventory (EBI). The study also examines the psychometric properties of each instrument and seeks to determine if a hierarchical factor structure emerges from the subscales across both instruments. To examine the association between factor scores and theoretically related constructs, multiple regression was utilized to explore the relationship between the factors and associated constructs of motivation, use of strategy, and implicit theories of intelligence, as measured by the Motivated Strategies for Learning Questionnaire and Implicit Theories of Intelligence Scale, respectively.

Findings and Conclusions: Supporting previous inquiries, the psychometric properties of the SEQ and EBI were less than optimal. Alpha coefficients were low to moderate, and principal axis factoring revealed poorly structured dimensions. Three and four factors were extracted for the SEQ and EBI respectively. As the statistical criteria for hierarchical factor analysis were not met, the intended second order factor analysis was abandoned, and the theoretically related constructs were regressed on first order factor scores. Of the three constructs, a significant relationship was only found between scores of motivation and the first order factor scores.

ADVISER'S APPROVAL: _____