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Epistemological Developmental Level and Critical Skill Thinking Level in Undergraduate University Students

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Epistemological Developmental Level and Critical Thinking
Skill Level in Undergraduate University Students

by

Monnie Huston Wertz

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
in Curriculum and Instruction with a concentration in
Interdisciplinary Education
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Dedication

This project is dedicated to my family, without whom none of this would have been possible. And to the God who fearfully and wonderfully made our minds, the subject of this study.

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I am thankful and humbled by the number of people who have assisted over time with this project.

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Abstract

Epistemological development and its relationship to critical thinking has been postulated in educational psychology since the 1970's. By empirically examining epistemological development in relationship to thinking critically, a richer understanding of overall student development and instructional needs could be achieved. By taking into account a student's epistemological development, issues unique to these stages could inform how to most effectively work with students to promote critical thinking development.

The purpose of this study was to explore the potential relationship between collegiate epistemological development and critical thinking skills by examining differences in critical thinking skills at different levels of epistemological development. The hypothesis of the study was that students reporting an epistemological level of either Absolutist or Evaluativist would have higher critical thinking scores than students reporting a Multiplist level. The instruments employed were the Cornell Critical Thinking Test (CCTT) and the Kuhn epistemological instrument. The study population of 157 students was taken from a medium-sized private institution in the southeastern United States.

The data indicated that the majority of the study population, 87%, identified as the Multiplist level of epistemological development, according to Kuhn's definitions. Overall critical thinking scores for the sample was lower than expected but still within

reported ranges. Analysis of variance tests were performed on the data and failed to indicate a statistically significant relationship in overall epistemological developmental level and four of the five individual epistemological judgement domains. This finding was not anticipated, challenges current theoretical understanding of this relationship, and indicates a need for further investigation of the nature of the relationship between critical thinking and epistemological development in the higher educational setting.

Chapter One: Introduction

Critical thinking (CT) is a lauded and coveted goal of American higher education (Burbules & Berk, 1999; Magno, 2010; Kuhn & Dean, 2004; Pascarella & Blaich, 2013; Tsui, 2000; van Gelder, 2005). University mission statements are filled with mentions of CT skill attainment as one of their highest aims. Yet, employers bemoan the lack of these skills in the college-educated workforce and clamor for more focus on CT skills throughout the educational system. So where is the disconnect? If higher educational institutions strive to cultivate these skills in their students and employers are supportive of their efforts, why is there an increasing perception in the US that students are falling further and further behind in this area?

Traditionally, the U.S. educational community supports CT as an integral goal. Foundational educator John Dewey, the National Institute of Education, the Association of American Colleges, the Commission of the Future of Higher Education, former Education Secretary Margaret Spellings, and the American Association of University Professors all agree that CT is an essential and fundamental part of American education (Arum & Roksa 2011; King, Wood, & Mines 1990). Randi Weingarten, president of the leading teachers union, American Federation of Teachers, cites CT as a skill necessary for “life and citizenship, college and career” (Kober, 2014).

But, despite an overwhelming view of its importance, U.S. students are not perceived to excel in higher order thinking skills. A 2010 Noel Levitz study and a 2014 Association of American Colleges and Universities (AACU) study both found that only

26% of employers scored college graduates as well-prepared in CT skills while 81% of employers cited CT and analytical reasoning skills as very important (Hart Research Associates, 2015; Jenkins, 2017). The AACU study also demonstrated the difference between student and employer perception of CT abilities. Sixty-six percent of students felt they were prepared for CT while only 26% of employers felt the same (Hart Research Associates, 2015; Jaschik, 2015). A survey conducted in May 2016 of over 76,000 managers and executives found that 60% report that new college graduates lack necessary CT skills while reference to CT in job postings have doubled between 2009 and 2014, according to an analysis by Indeed.com (Jenkins 2017; Korn 2014).

With this support from the mainstream U.S. employment community, emphasis from U.S. educators, as well as the theoretical and methodological expertise from three different disciplines (psychology, philosophy, and education), CT skills should be on the rise in the U.S. But, conversely, CT skills are thought to have deteriorated over time despite increased efforts to include it in curricular goals.

Many causes have been cited in academic journals and the general media for this perceived decline including the rise in high-stakes testing, an increased emphasis on content-driven curricular models, overindulgent or “helicopter” parenting, and the self-esteem movement, in which children are praised for effort rather than success (Arum & Roksa, 2011; Behar-Horenstein & Niu, 2011; Butler, 2012; Halpern, 1999; Hirsch, 2016; Jenkins, 2017; Kuhn, 1999; Liu, Frankel, & Roohr, 2014; Miri, David, & Uri, 2007; Ravitch, 2016; Terenzini, Springer, Pascarella, & Nora, 1995). And there have been a myriad of pedagogical and curricular efforts to teach higher order thinking but none have brought about marked and long-lasting improvements in skill development (Abrami, Bernard, Borokhovski, Wade, Surkes, Tamim, & Zhang, 2008; Arum & Roksa,

2011; Halpern, 1998; Hanley, 1995; Huber & Kuncel, 2016; Li & Kettinger, 2006; Magno, 2010; Marin & Halpern, 2011; Niu, Behar-Horenstein, & Garvan, 2013; Pascarella & Blaich, 2013; van Gelder, 2005). As with most issues, the roots seem to be multi-dimensional and conceptually complex.

As an educator in a collegiate environment for over 20 years, I have observed first-hand a decline in CT skills in the university students with whom I work. Beginning around 2002, my students began to demonstrate a marked decline in the ability and desire to engage and solve even the most routine problems. An instance of a course not being offered in the desired semester or lack of a washing machine during a free period in their schedule could now result in large emotional outbursts, threats of self-harm, and immediate calls to the counseling center, academic advisors, and/or parents. In addition, I have observed students' growing inability to sort through the increasing amount of information available to them through technology, to evaluate the reliability and authenticity of that information, and to make basic decisions based on evidence and experience. This inability poses both academic and personal issues for these students.

There is some evidentiary basis for this perceived and observed lack of CT skill in collegiate students. The College Learning Assessment Plus (CLA+) has been used to measure students in three distinct areas: scientific and quantitative reasoning, critical reading and evaluation, and critique an argument (Council for Aid to Education, 2017). This measure has been used at over 200 colleges across the US and the data gathered between 2013 and 2016 showed little evidence of student growth in these areas over a student's collegiate career (Belkin, 2017). This echoes similar findings from Arum and Roksa in their book, *Academically Adrift*, using the same measure of higher order thinking skills (2011).

But there is a consistent interest in pursuing higher order thinking as a goal on the collegiate level. As measured by the Higher Education Research Institute at UCLA in their faculty survey published in 2009, U.S. university faculty rank as their highest goal for their students to “develop ability to think critically” (DeAngelo, Hurtado, Pryor, Kelly, Santos, & Korn , 2009). Much of educational reform in the last few decades has emphasized and prioritized CT as an objective (Butler, 2012). The modern characterization of higher education as a public good rather than a private good only for the individual highlights the need for higher order thinking skills as a function of all citizens (Facione, 2011).

Rationale

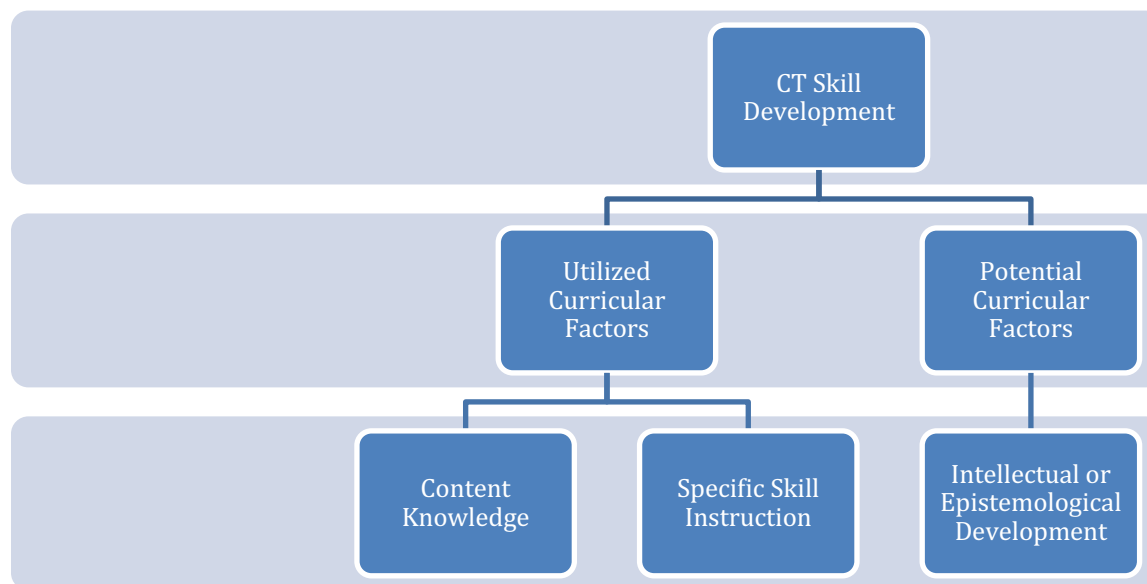
So where should U.S. education go from here? Perhaps the re-examination of a neglected developmental concept can provide some additional context to existing efforts or provide a positive shift to the current mindsets of what is necessary for students to acquire these skills. Epistemological development is a process that has received little attention in the academies of today. Traditionally, epistemology has been defined as how one distinguishes justified true belief from opinion and students are thought to develop in this area as they progress through their educational experiences. Despite the onslaught of “fake news” and information creation from millions of possible sources, the way that students are developing their own ideas of knowledge and understanding of how subjective and objective knowledge weave together has been neglected. If there is a relationship between epistemological and critical thought development, then educators could have an important tool to evaluate their students readiness to engage in CT to better tailor instruction in that area, and potentially change an emphasis in collegiate education.

Previous generations of educators emphasized skill development to the detriment of content knowledge (Hirsh, 2016; Ravitch, 1983). But presently, students are coming from a content-heavy background, courtesy of the standards-based, mastery components which were foundational elements of the No Child Left Behind program (Schoen & Fusarelli, 2008; Sloane & Kelly, 2003). Common Core appears to attempt to strike a middle ground between these two competing schools of thought, content knowledge versus skill development. But, regardless of K-12 background, college professors may take for granted the epistemological development of their students (Scheurman, 1996). This disconnect between expected development and actual development may encourage utilization of inappropriate content or pedagogical techniques by the professor which could negatively affect student learning. And, when student development or ability is not up to expected standards, most remediation programs are content and basic skill development based rather than examining more higher-order processes (Huber & Kuncel, 2016; Miri et al., 2007; Niu et al., 2013; Terenzini et al., 1995).

The background of the present investigation can be graphically represented in Figure 1 below.

If a student's epistemological development can be demonstrated to be a factor in CT skill development though establishing a relationship between the two constructs, this can add to the currently identified curricular factors that contribute to this type of education with collegiate-level students.

Figure 1

Graphical Description of Theoretical Background of Present Study**Purpose**

As I have studied the issues surrounding the perceived and observed decline in CT skills within collegiate populations with more diligence and assistance through my doctoral program, I have identified one particular area which has been underexplored in published, peer-reviewed research and may be able to assist in improving the CT development of students. This study is designed to examine the relationship between CT skill development and epistemological development that has been largely neglected to date. It is hoped that by providing some empirical clarity regarding this largely theoretical relationship, educators may be able to utilize the nature of this relationship and its impact on CT skill development to improve their planning and practice.

Key Constructs

CT is an umbrella concept or meta-process that incorporates a group of cognitive processes within its construct. These processes include problem solving, meta-cognition, decision-making, and inquiry skills. These skills are thought to be developed within a content discipline and may have limited transferability across areas (McPeck, 2017). Some academic disciplines and academic majors are thought to be more suited for developing higher-order thinking skills than others (Huber & Kuncel, 2016; King et al., 1990). But there are scholars who feel that transference is possible and should be an overall goal of education (Halpern, 1998; van Gelder, 2005). Regardless of transference, these skills are desirable and expected as students develop and mature along curricular paths. The act of engaging in these skills is thought to encourage the disposition of continued engagement in all higher order thinking skills and may encourage students to continue to develop these skills throughout their educational and personal ventures (Facione et al., 1995; Ku & Ho, 2010).

Epistemological development has been linked to CT in three different disciplines: psychology, philosophy, and education (Daniel & Auriac, 2011; Facione, 1990; Facione, 2011; Halpern, 1999; Hofer & Pintrich, 1997; King & Kitchener, 1994; King, Wood, & Mines, 2004; Kuhn, 1999; McPeck, 2017; Piaget, 1971; Sternberg, 1986; West, 2004). While some of the specific vernacular may differ, these fields hold similar ideas regarding the ability of students to engage in CT and its relationship to how students evaluate knowledge. Philosophy traditionally sees CT in terms of logic systems and theoretical reasonings (McPeck, 2017; Sternberg, 1986). Psychology uses language which refers to the specific process underlying the overarching concept specifically the

cognitive and meta-cognitive skills (Hanley, 1995; Kuhn, 1999; Magno, 2010; van Gelder, 2005; Wilen & Phillips, 1995).

Within education, William Perry (1960) began the conversation by looking at how students' intellectual development, his term for epistemological development, affected their abilities as students. His target student population was collegiate-aged and his theoretical development has matured and developed through the interpretation and work of other educational thinkers such as Marcia Baxter Magolda, Marlene Schommer-Aikins, Barbara Hofer, Patricia King, and Karen Kitchener. One specific theorist, Deanna Kuhn, has specifically connected epistemological development and CT (Kuhn, 1999; Kuhn, Cheney, & Weinstock, 2000).

Hypothesis

Many theorists connect epistemological development with the development of CT or at least to some of its sub-processes, such as problem solving, evaluation of evidence, and developing arguments (Battersby, 1989; Baxter Magolda, 2014; Facione, 1990; Hofer, 1994; King & Kitchener, 1994; King & Kitchener, 2004; King et al., 1990; Locker, 2006; Perry, 1970; Piaget, 1971; West, 2004). One theorist in particular, Deanna Kuhn, has proposed a direct link from epistemological development to CT skills. Her theory posits that as students move along an epistemological developmental continuum, their interest in and ability to critically think fluctuates. She proposes four developmental levels through which a person should progress sequentially. These are: Realist, Absolutist, Multiplist, and Evaluativist. A Realist is the beginning stage, usually found in preschool children, where knowledge is an exact copy of reality. No critical thought is necessary as knowledge is accepted from outside sources as certain. At the next level, Absolutist, students utilize CT for comparing assertions to an idea of objective

knowledge. As they move to a more relativistic phase, Multiplist, CT becomes irrelevant as all knowledge is perceived to be subjective. If and when students progress to the most advanced stage, Evaluativist, CT becomes valuable as a way to balance the objective and subjective and to promote knowledge formation (Kuhn, 1999; Kuhn et al., 2000).

Traditional-aged college students, 18-24, are thought to reside on this continuum of three levels with significant changes occurring during their time in higher educational environments (Kuhn, 1999; Kuhn et al., 2000; Perry 1970). If students are coming to college with more rudimentary epistemological developmental levels, not anticipated by faculty members, they may actually be moving away from an interest and application in critical thought, into a Multiplist level, which would explain my anecdotal observations and some of the recent criticisms about the lack of higher order thinking skills within this generation of students. This mismatch between professor expectation of developmental level and actual development may create a disconnect between instructional methods/focus and actual ability of students to learn.

I would like to test the existence of the relationship between epistemological development and CT. I will be utilizing Kuhn's four-tier theory of epistemological development and Robert Ennis' definition of CT, including induction, deduction, observation, credibility, assumptions, and meaning, as a priori rubrics for understanding and organizing the data collected in the study (Ennis, 1993; Kuhn, 1999). My contention would be that there is a relationship between these two constructs, as demonstrated by theorists' assertions and observed skill development. I would like to examine if and how CT skill level is related to epistemological developmental level. This would be done utilizing a quantitative, correlational study. Critical thinking will be

measured using a quantitative instrument and scored on an interval scale.

Epistemological development will be measured using a survey instrument and scored on an ordinal scale. The expected relationship would be higher CT scores would reflect either an Absolutist or Evaluative developmental level. Lower CT scores would reflect a Multiplist level.

Research Questions

The research questions driving this study are as follows:

1. What is the distribution of epistemological developmental levels among traditional-aged first year college students enrolled in a private, metropolitan university?
2. To what extent, if any, is there a relationship between measured CT skill development and the identified level of epistemological development in first year college students enrolled in a private, metropolitan university?

Limitations

This study will occur in one location, a mid-sized private university in the southeastern United States, with traditionally-aged first year college students.

Therefore, the generalizations that may be drawn from the study will be limited to first-year students attending this particular institution during this given year.

The limitations of the study include the singular location, small sample size, limited utilization and testing of the epistemological survey used in the study, and the lack of control for potentially confounding variables (gender, high school size, national origin, GPA, standardized test scores).

Importance of Study to Theory and Practice

Many things in the pursuit of CT skill development are taken for granted. Basic definitions are assumed to exist even though it is clear that the general public has very different concepts of CT skills than a philosopher or an educator (Facione, 1990; Korn, 2014; McPeck, 2017). The ease of developing these skills is another misconception as demonstrated by the lack of success in skill attainment cited frequently by educators and business leaders (Arum & Roksa, 2011; Berliner & Glass, 2014; Huber & Kuncel, 2016; Jenkins, 2017). The curricular requirements are presumed yet the long-standing debate between content knowledge instruction and skill development instruction has also proven unfruitful as it appears that these skills must have both components to flourish (Hirsch, 2016; Halpern, 1999; McPeck, 2017; Ravitch, 2016). So, a more sophisticated and empirical understanding about how these skills may be formed is needed to improve their development in educational environments. This study can add to this empirical understanding by providing evidence as to the relationship between students' epistemological development and their ability to think critically. This specific piece seems to be missing from the current literature and could provide a powerful tool to understanding holistic student educational development and, in turn, remove some current impediments to student skill development.

Chapter Two: Literature Review

Developing CT among students is a stated goal of American K-12 education yet success in achieving this goal is receiving mixed reviews. A succinct definition of CT has offered by leading researcher Robert Ennis as, “reasonable reflective thinking focused on deciding what to believe or do” (Ennis, 1993, p.180). Post-secondary institutions that are receiving students with underdeveloped CT skills need an increased understanding of how to foster critical thought in their own students. Large, longitudinal studies as well as small, discipline specific studies have suggested a myriad of differing strategies, pedagogical techniques, and methods for improving a student’s CT skills (Abrami, Bernard, Borokhovski, Wade, Surkes, Tamim, & Zhang, 2008; Halpern, 1999; Niu, Behar-Horenstein, & Garvan, 2013; Shim & Walczak, 2012). But the lack of CT skills among students may not only be a result of pedagogical or strategic deficits, but also there may be students who are not situated in a developmental place to be successful critical thinkers.

Some scholars believe epistemological development can affect a student’s application and usage of CT skills. Researchers such as Deanna Kuhn, Patricia King, and Karen Kitchener believe that epistemological development and CT are related; yet this belief has not been widely empirically tested. Rather than attempt to confront the totality of CT skill development, I have selected to focus on the relationship between CT and epistemological developmental level. These two constructs have been thought to be

related by scholars from philosophy and education and by further investigating this theoretical relationship, my hope is that the path to educating students to think critically may become clearer. If students can be identified who are able (epistemologically appropriate) to apply CT skills, then instruction in these skills can be more productive and students' applications of these skills will be more effective.

This literature review covers scholarship on the importance of CT skill development in the higher education environment and the relationship between epistemological development and CT. Topics relating to CT pedagogy, the relationship of CT to factors such as cognitive processes will not be discussed. I will begin by describing the background of the importance of critical thought in higher education and then will highlight the current state of CT education in the US. Next, definitions of the constructs from the three different academic disciplines that study critical thought will be provided, followed by significant works and discussions of epistemological development as well as its relationships to CT. For brevity, I will refer to critical thinking going forward as CT in most instances.

Critical Thinking is Important for College Students

CT has long been a primary educational goal in democratic societies such as the United States (Magno, 2010; Pascarella & Blaich, 2013; Tsui, 2000; van Gelder, 2005). Thomas Jefferson articulated the purpose of higher order thinking (which for the purpose of this literature review will be used interchangeably with CT) in education when he said:

I know no safe depository of the ultimate powers of the society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion by education. (Kuhn & Dean, 2004, p. 268).

More recently, the scholar Harry Siegel shared this thought about the impact of CT, which he claims fosters self-sufficiency, "...a self-sufficient person is a liberated person...free from the unwarranted and undesirable control of unjustified beliefs" (Burbules & Berk, 1999).

The importance of CT has been qualified in U.S. education by its inclusion in national initiatives such as the US Department of Education's "Goals 2000: Educate America Act". This act identifies in Goal 5 that adult Americans will possess the ability to exercise the rights and responsibilities of global citizenry and this will be accomplished by, "the proportion of college graduates who demonstrate an advanced ability to think critically, communicate effectively, and solve problems will increase substantially" (Facione, Sanchez, Facione & Gainen, 1995).

The Complexity of Defining Critical Thinking

A main issue in educating students in CT skills is the complexity of defining CT itself (Huber & Kuncel, 2016; Niu et. al., 2013). The construct has its origins in many disciplines and has been studied using a variety of definitions, theoretical frameworks, and methodologies. One researcher recently noted, "Conceptually, it is essential that we know precisely what we mean when we refer to CT or thinking skills, if the constructs are to be useful" (Kuhn, 1999, p.17). The ideas of John Dewey, commonly considered the

founder of the modern CT movement in the United States, have informed not one but all three disciplines from which CT is thought to come: philosophy, psychology, and education (Sternberg, 1986). CT has the benefit of thought and research from these three distinct content areas and, while this diversity of perspective creates a richness to the concept which may not be enjoyed by other theoretical constructs, it does contribute to the confusion about what is actually meant by critical thought. Looking at the construct through these differing disciplinary windows, the views can be quite different. But these are basic structures that exist across the disciplines that assist in developing an operational construction for the concept of critical thought.

Each discipline provides for what CT is, how it is accomplished, and the goal of the thinking. And their definitions are not exceptionally wide. In looking at what CT is thought to be, the philosophical ideas of reasoning and judgment are actually more fully described by understanding the underlying psychological processes. These processes then, in turn, make up the reflective judgment cited by education as what CT is. The how of CT is the widest point between disciplines but most components are redundant between disciplines, describing things like considering evidence and methods, solving problems, evaluating arguments, making judgments, developing and defending opinions, identifying bias and credibility, and defending decisions. The goals of CT are the narrowest with all three disciplines agreeing that the purpose of this type of thinking is to enable a person to establish belief or action.

Some of the criticisms leveled at the educational system in relationship to CT may be the result of differing definitions of critical thought. While most parents, educators, and policy makers concur that CT should be a goal of the educational process, there is far less consensus in the definition of what is meant by saying “critical thinking.”

Table 1

Comparison of Critical Thinking between the Disciplines of Philosophy, Psychology, and Education

	Philosophy	Psychology	Education
Definition	“...purposeful, reflective judgment which manifests itself in reasoned consideration of evidence, context, methods, standards, and conceptualizations in deciding what to believe or do” (Facione, 2011, p. 22)	“CT is the disciplined mental activity of evaluating arguments or propositions and making judgments that can guide the development of beliefs and taking action” (Huitt, 1998, p. 3)	“CT is reasonable reflective thinking focused on deciding what to believe or do” (Ennis, 1993, p. 180)
Goals	Philosophy remains primarily interested in the formal logic systems involved in critical thought (McPeck, 2017; Sternberg, 1986)	Psychology is interested in the cognitive development and processes in play underpinning CT (Sternberg, 1986).	The general consensus in education is that CT skills are not fixed but can be taught (Halpern, 2001; Niu et. al, 2013)
Accomplishment	Philosophy does not view CT as an innate ability but one that requires development. This development is thought to occur through the means of praxis rather than knowledge to be memorized or techniques to be learned (Daniel & Auriac, 2011).	The most dominant component of CT is thought to be a person becoming skilled at using both cognitive and metacognitive skills (Hanley, 1995; Kuhn, 1999; Magno, 2010; van Gelder, 2005; Wilen & Phillips, 1995)	A focus on outcomes affects how educators work to form CT skills in students and differentiates this discipline definitionally from philosophy and psychology that focus more extensively on the processes used by critical thinkers.

For example, colleges and universities may not be using the same goal or definition of CT that employers are using. In modern society, “critical” has been

accepted to mean dispassionate or analytical thinking - removing the emotion and bias from issues and examining them using facts and reasoning (Jenkins, 2017). In contrast, CT may also be conflated with definitions of critical theory in academe (Burbules & Berk, 1999; Jenkins, 2017). Linda Elder, president of the Foundation for CT and an educational psychologist, believes that employers want specific problem-solving skills but not necessarily the totality of CT in new graduates. She articulates that CT can challenge the status quo, which may be undesirable in new employees (Korn, 2014). In light of this conceptual confusion, it is important to explore the meaning of CT through each of the three lenses—philosophy, psychology, and education—to fully understand the complexity of the construct.

The Philosophical View

In 1987, the American Philosophical Association assembled a group of scholars to address the topic of modern CT. Their efforts resulted in a report published in 1990, the Delphi Report. This group created a definition of CT, “...purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based” (Facione, 1990, p.2). They conceptualized the theoretical construct of CT as two dimensional, cognitive skills and affective dispositions (Facione, 1990). The cognitive skills include interpretation, analysis, evaluation, inference, explanation, and self-regulation and affective dispositions were made up of factors such as fair-mindedness in appraising reasoning, prudence in suspending, making, or altering judgments, and clarity in stating the question or concern (Facione, 1990). Another noted philosopher inimical to the modern

CT movement, Robert Ennis, constructed a more basic definition cited above, “Critical thinking is reasonable reflective thinking focused on deciding what to believe or do” (Ennis, 1993, p. 180).

Philosophy remains interested in the formal logic systems involved in CT although there is a debate within the community as to the relationship between CT and informal logic (McPeck, 2017; Sternberg, 1986). Some contemporary philosophers use the terms interchangeably while others posit informal logic is too limiting and sterile to compose all of the complexity that represents CT (Battersby, 1989; McPeck 2017). Philosophy rejects the idea that all “good” thinking is CT and defines it separately from other thinking such as creativity, innovation, purposive, kinetic, instinctive, and meditative (Facione, 2011). There seems to be agreement, however, that epistemology is a related process to CT and is foundational to the construct (Battersby, 1989; McPeck, 2017; Siegel, 1989).

In the spirit of expanding CT beyond basic logistical processes, there is a growing idea in philosophy that the modern purpose of CT represents what used to be thought to be the value of a liberal arts education and the ability of this type of education to produce educated citizens (Battersby, 1989; Facione, 2011; McPeck 2017). Seen as dialectic, criticality is believed to contribute to the freedom of thought through reasoning which is thought to be foundational to higher education (Butler & Spivak, 2001). If this is true, this contributes to the perceived importance of CT in the United States and the necessity of a more robust understanding of the construct and how it is formed in an educated populace.

The Psychological View

Psychology takes a different theoretical view of CT. Robert Sternberg, one leading theorist, states CT “comprises the mental processes, strategies, and representations people use to solve problems, make decisions, and learn new concepts” (Sternberg, 1986, p. 2). Another educational psychologist, William Huitt, offers another definition, “critical thinking is the disciplined mental activity of evaluating arguments or propositions and making judgments that can guide the development of beliefs and taking action” (Huitt, 1998, p. 3). In both definitions, the theme of mental processes and activity is evident. While it is widely recognized that CT is cognitive work, the subject of whether or not CT is a function of cognitive ability is still debated by researchers (Halpern, 1998). CT is not viewed as the same construct as intelligence or cognitive ability (Butler, 2012). Some studies have suggested that CT is positively correlated with emotional intelligence and may bridge the gap between intelligence and emotions (Niu et. al., 2013). Other theorists maintain the close relationship between CT and meta-cognition/meta-knowing (Kuhn, 1999; Magno, 2010). One researcher specifically situates CT as an outcome of meta-cognition. This relationship is described as meta-theoretical because an executing strategy, such as metacognition, is required to produce an executive skill, the CT (Magno, 2010). Overall, psychology is interested in the cognitive development and processes in play underpinning CT (Sternberg, 1986).

The Educational View

Philosophical theories tend to be competence theories specifying what people can do; psychological theories tend to be performance theories specifying what people actually do; educational theories are

often a mixture of the two, with the nature and proportions of the mix less than clearly specified. (Sternberg, 1986, p.6)

As the statement above illustrates, educational environments provide a practical mixture of the disciplines of philosophy and psychology (Halpern, 1998; Niu et al., 2013). As one of the general purposes of education is to foster CT, then it should be a theme throughout all levels of schooling and not only reserved for collegiate education (Burbules & Berk, 1999; Facione, 1990). And most educators are interested in how these skills can be taught in classroom settings (Sternberg, 1986).

One of the reasons that education has articulated such a clear focus on CT is that CT skills are necessary for working through every-day, ill-defined problems (Halpern, 1998; King et al., 1990). Some educators have turned to Bloom's Taxonomy, particularly the upper two levels, synthesis, and evaluation, where his model becomes less hierarchical and includes more higher order thinking to understand CT and its applications in education (Huitt, 1998). Issues with using Bloom's Taxonomy as a basis of defining CT exist in the confusion between critical and creative thinking, which may be represented by the evaluation and synthesis levels, respectively, but it is not definitive (Huitt, 1998).

Some disciplines are better suited to well-structured problems (math, computer science) while others to ill-structured problems (social sciences) although there is no conclusive information that specific majors make greater gains in CT over the college span with the exception of philosophy (Huber & Kuncel, 2016; King et al., 1990).

Regardless of discipline, it is important that instructors/professors on every level infuse higher order thinking instruction into their programs and courses (Huitt, 1998).

CT skills are best developed and used when learned in content specific courses rather than courses simply designed to teach CT (Huitt, 1998; van Gelder, 2005). One researcher, using a case study approach, found that institutions where students reported growth in CT skills emphasized the process of how knowledge is acquired rather than the sum total of the knowledge acquired itself. These institutions employed a wide variety of pedagogical techniques and engaged in critiques of what is perceived as established knowledge (Tsui, 2000).

How instruction is executed is thought to be foundational to the development of higher order thinking skills and should be of significant interest to educators. Explicit CT instruction has been shown to be more effective than implicit CT instruction although the majority of research on this topic has been done in traditional K-12 settings (Butler, 2012; Marin & Halpern, 2011; Miri, David, & Uri, 2007). And, while specific interventions to promote CT have not been demonstrated to create significant change, college attendance generally appears to have a positive effect (Arum & Roksa, 2011; Butler, 2012; Huber & Kuncel, 2016). This may be attributed to general education courses taken during the first two years of college, which may expose students to a greater number of ill-structured problems although Arum and Roksa (2014) would argue that the latter part of collegiate curriculums, with more individualized and seminar courses, would promote more exposure to CT (Scheurman, 1996). Another study found that the number of years of education was predictive of CT scores rather than age leading to the conclusion that CT skills were improved through instruction (Butler, 2012).

A recent meta-analysis of 31 studies provided further support for educators that instructional interventions are generally effective in promoting and improving college

students' CT skills (Niu et al., 2013). The included studies illustrated that small gains over time were to be expected with explicit CT instruction rather than dramatic increases, as would be expected with subjective knowledge. Skill building is a gradual process and should take place over a long-term period (Niu et al., 2013). Their conclusion from the meta-analysis is that CT skills of college students, as measured by a number of different instruments, can be improved through classroom instruction (Niu et al., 2013). And this classroom instruction takes on specific significance as CT scores have been connected to using CT skills in real world situations (Butler, 2012). So, while specific content material may be forgotten or outdated, skills such as CT taught within that content can and should be a college's contribution to a student's life-long learning (Terenzini et al., 1995).

Apparent Decline of Critical Thinking Skills in Collegiate Populations

With this research and emphasis from American educators on CT and the advantage of theoretical and methodological expertise from three different disciplines, CT skills should be on the rise within educational systems and among populations with increasing educational attainment. But, conversely, CT seems to have deteriorated among students over time despite increased efforts to include it in curricular goals. Explanations for this decline include students coming to college with reduced readiness and/or willingness to learn these skills (Huber & Kuncel, 2016). And not only educators but also employers agree that college students are deficient in CT skills (Niu et al, 2013). Citing research by Pascarella and Terenzini (2005), the initial gains in CT noted in their 1995 study during the college experience have declined. Their sample was 600 freshman students from a large, commuter university who were given both a pre-and post-test to measure changes in skill level (Terenzini et al., 1995). Specifically, collegiate seniors

dropped .5 standard deviations (*SD*) in the 1995 study as compared to a pre-1990s study. This lack of significant progress over four collegiate years is also supported by Arum and Roksa (2011) through their study using the Collegiate Learning Assessment (CLA), which differs from instruments used by Terenzini et al. (Huber & Kuncel, 2016). The CLA measures student success along three different constructs: CT, complex reasoning, and writing. Arum and Roksa (2014) actually reported greater gains by collegiate student in their first two years than in the last two, despite their course loads becoming more difficult and sophisticated.

One issue may be the learned nature of CT skills and the effort needed to utilize them. Humans are not naturally critical and any higher-order cognitive operation is difficult. An educational psychologist has made the analogy of running being a natural activity for a human but the transition to ballet dancing, which is highly specific and disciplined, requires far more instruction and study (van Gelder, 2005). A remedy could be that researchers can identify forms of development that will benefit from specific instruction and are unlikely to develop in current systems. Educators can then utilize this developmental knowledge to inform their classroom planning and activities (Kuhn & Dean, 2004). If higher order thinking skills are a desired outcome of education and perceived as critical to a democratic populace, then researchers and practitioners need to come together to determine how to best develop those skills (Kuhn & Dean, 2004).

Another issue, students the desire to gain and use these skills, or the disposition to think critically, has been the topic of interest to researchers, in all three relevant disciplines. Although dispositional conversations began in philosophical circles, educational psychologists soon began to recognize its importance as well. CT was recognized to be “cognitive work” that required application of significant mental effort

and a recognition of the need to use it (Halpern 1998; Halpern 1999). It was recognized that CT skills are not used out of habit but require an understanding of the value of critical thought to encourage the use of acquired skills (Kuhn, 1999).

The field of education also became interested in the disposition to think critically. Dispositions began to be seen as an educational norm and necessary for the successful utilization of CT skills (Norris, 1989). Educational studies began to connect CT and CT dispositions positively through research (Facione, 1995; Ku & Ho, 2010; West et al., 2008). In a study investigating heuristics and biases as measures of CT, researchers found that CT dispositional measures were independent predictors of CT skills (West et al., 2008). Over 700 undergraduate subjects completed three different tasks in order, beginning with thinking disposition, then syllogistic reasoning and then finally a heuristics and biases task. These results were then analyzed using correlation and regression statistics (West et al., 2008). Another study with Chinese nursing students found that CT dispositions exert “significant and unique influences” on CT achievement that are independent of cognitive skills (Ku & Ho, 2010). This study again utilized undergraduate students as a sample with a smaller number at 137. Five different factors were tested using a hierarchical regression analysis (Ku & Ho, 2010).

An additional issue is the curricular basis from which to foster CT skills. The advent of the progressive educational movement in the first half of the twentieth century rejected traditional subject-based, teacher-led educational environments for new and more modern ones. Citing the writings of Dewey and others, traditional educational curriculums were replaced with learning through projects and experiences, cooperative planning by students and the teacher, group projects as opposed to competition for grades, assigning value to subjects in relation to its value to life outside the classroom

and in the community, and individualized planning based on specific student needs (Ravitch, 1983). Noted educator E. D. Hirsch identified three of the most dominant practices supported by progressives as naturalism, individualism, and skill-centricism (Hirsch, 2016). Other innovative educators, such as Paulo Freire, rejected the traditional, singular content-based instruction. Freire referred to traditional methods as a “banking” model of education and found it was an inefficient and inequitable form of education, particularly for poor and disenfranchised sections of the population (Freire, 1996). He emphasized differentiated pedagogical techniques depending on the experiences and needs of the specific community being served (Freire, 1996). Part of these efforts included an emphasis on skill-based learning and problem solving, to the exclusion of the rigid, specific content and subject knowledge emphasis. Progressive educators touted CT skills as a specific outcome of their curricular focus but the difficulty in measuring skill acquisition, particularly in higher order thinking, has made quantification of gains difficult (Arum & Roksa, 2011; Lai, 2011). Partially because of the lack of evidence but also based on theoretical differences, progressive ideals in education have strong detractors.

During the Reagan administration in the 1980s, a new curricular model began to gain attention. It was actually supportive of a return to pre-progressive practices and was articulated through the writings and research of educators such as E.D. Hirsh, Allan Bloom, Diane Ravitch, William Bennett, and Chester Finn (Berliner & Glass, 2014). Hirsh’s best-selling book, *Cultural Literacy*, brought the idea of content as preeminent back into the mainstream of by suggesting that U.S. education needed to be providing a set of common knowledge to serve as a unifying force for the citizenry among its vast diversity (Berliner & Glass, 2014; Hirsch, Kett, & Trefil, 1988). Hirsh and others

denounced the idea of CT being taught as a skill but rather solely in the context of specific content contexts. Hirsch has gone as far as to say, “The general skill of critical thinking does not exist...” (Hirsch, 2016). This sentiment puts him, and other supportive theorists and educators, in direct opposition to those who believe that skill-based instruction is the most productive in creating these skills. Diane Ravitch claimed that the progressive movement had distorted the goals they were trying to accomplish. “Educators tried to use their own educational practices to address the crises that faced almost every decade of the twentieth century, but did it by inverting Dewey’s idea that schools should help shape society into schools shaping the individual to adjust to the society” (Ravitch, 1983; Ravitch, 2011). This curricular debate is still on-going, mired in discussions about standardized testing, skill transference issues, and the purpose and definition of education in America (Finn, 1990; Hirsch, 2016; Ravitch, 2011).

But could there also be another issue that has only been theoretically identified to date, which hinders growth in collegiate CT skills? Could the lack of epistemological development in contemporary college students be undermining well-meaning and well-designed instructional interventions? As various educational theorists have postulated a relationship between these two constructs, it is a worthy one to investigate.

Epistemological Development Relationship to Critical Thinking

The development of epistemological understanding may be the most fundamental underpinning of CT. If knowledge is entirely objective, certain, and simply accumulates, unconnected to the human minds that do the knowing – as the absolutist conceives – or if knowledge is entirely subjective, subject only to the tastes and

wishes of the knower – as the multiplist conceives – critical thinking and judgment are superfluous. (Kuhn, 1999, p. 23)

Epistemology has been studied from the early moments of Western society. Plato is credited as defining knowledge as “justified true beliefs” and epistemology emerged as the way to discover what constituted a justified true belief and how they were developed (Li & Kettinger, 2006). Other philosophers such as Aristotle, Descartes, Kant, and Hegel joined Plato in creating the basis of the understanding of the theory of knowledge (Miller, 2011; Piaget, 1971). Modern epistemological studies have moved from a primarily deductive philosophical theory to incorporate empirical studies, influenced by emerging ideas of development in psychology, to become a more inclusive field of study (Hofer & Pintrich, 1997; Kuhn & Park, 2005; Piaget, 1971). Epistemological researchers have begun to concentrate on specific populations and there is a growing body of research on the epistemological development of collegiate students.

Collegiate Epistemological Development

Many theorists, beginning with William Perry (1970), identify the importance of epistemological development in collegiate populations and theorize how this development takes place. While the pace of development and conceptual language differ, most modern theories conceive students moving from a fixed, dualistic place of absolute certainty through an introduction of the subjective and associate relativism to finally a sophisticated, evaluative consideration of knowledge (Baxter Magolda, 2004; Hofer & Pintrich, 1997; King & Kitchener, 1994; Kuhn, 1999; Paulsen & Feldman, 2005; Perry, 1999; West, 2004). Not all epistemological development models reflect a formal, structural, sequential model but may focus on how epistemology affects

differences in thinking and reasoning or characterizes epistemology as a system of belief (Hofer & Pintrich, 1997). But even in these non-structural models, the basic process of a developmental movement, similar to cognitive development, remains constant. Most scholars agree that there is a developmental progression in adult epistemological development, especially in those who have participated in post-secondary educational programs (Baxter Magolda, 2004; Hofer & Pintrich, 1997).

Epistemological development and its relationship to CT has been postulated in educational psychology since the 1970's. Some scholars define CT in terms of epistemology saying, "The critical thinking tradition concerns itself primarily with the criteria of epistemic adequacy" (Burbules & Berk, 1999, p. 46). Psychologists include epistemological development when they claim, "developmental phenomena are currently being studied that are of direct relevance to understanding and fostering critical thinking" (Kuhn, 1999, p. 16). Rationality, a larger umbrella concept under which the construct of CT is situated, is thought to be composed of two parts, one of which is epistemic (West et al., 2008). Philosophers recognize the relationship between CT and epistemology as one where CT assists in establishing epistemological norms (Battersby, 1989). In their well-researched and documented work in reflective judgment, King and Kitchener have studied epistemic cognition and found it intimately connected to the solving of ill structured problems and how people's responses to these problems change over time as they develop epistemologically from early adolescence to adulthood (King & Kitchener, 2004). They go on to define the type of higher order thinking that is involved in solving ill structured problems as involving reflective judgment, a term they attribute to the work of John Dewey (King & Kitchener, 2004). So, through many theories, disciplines, and scholarly work, epistemology and CT seem

significantly intertwined.

Beyond the general, more structural connection between CT and epistemology, how does this connection work to assist in understanding and educating students to critically think? Theories about personal epistemological development provide important insight into the significance of that relationship for educators. William Perry established the modern foundation for the understanding of epistemological development. Working with a collegiate population, he began to suggest a way of understanding how students made meaning of their educational experiences and began conducting research on epistemological beliefs in this population (Hofer & Pintrich, 1997; Perry, 1970). This research culminated in a theory of epistemological development, which could be characterized in four general categories (Hofer & Pintrich, 1997; Locker, 2006). The first, dualism, is characterized by a strict right or wrong orientation to knowledge and a view that authorities are the best source of information and instruction. Objective knowledge is seen as paramount. The next category, multiplicity, is indicated by a change to understanding that there is diversity of opinion and some uncertainty in knowing. Subjective knowledge becomes most important and different opinions become equally valid in this stage. Relativism follows as the next category with the knower taking the prominent position in the creation of knowledge. Objective and subjective knowledge begin to work in partnership together to create context for the evaluation of knowledge. The final category is commitment within relativism where the individual begins to use their created knowledge to take action steps in their own lives with regard to career, personal, and political choices (Perry, 1970).

Based on Perry's work, other modern theories of epistemological development have emerged that specifically examine epistemological development in late adolescence and early adulthood. Hofer and Pintrich's landmark article investigated the predominant theories, identified areas of intersection and conflict, and suggested directions for future research (Hofer & Pintrich, 1997). This summary provided a greater understanding of the research being conducted with respect to epistemological development and provided contrast between differing theories. Their summary of theories is listed in the table below.

Table 2

Models of Epistemological Development in Late Adolescence and Adulthood (Hofer & Pintrich, 1997)

Intellectual and ethical development (Perry)	Women's ways of knowing (Belenky et al.)	Epistemological reflection (Baxter Magolda)	Reflective judgment (King and Kitchener)	Argumentative reasoning (Kuhn)
<i>Positions</i>	<i>Epistemological perspectives</i>	<i>Ways of knowing</i>	<i>Reflective judgment stages</i>	<i>Epistemological views</i>
Dualism	Silence Received knowledge	Absolute knowing	Pre-reflective thinking	Absolutists
Multiplicity	Subjective knowledge	Transitional knowing	Quasi-reflective thinking	Multiplicists
Relativism	Procedural knowledge (a) Connected knowing (b) Separate knowing	Independent knowing		Evaluatists
Commitment within relativism	Constructed knowledge	Contextual knowing	Reflective thinking	

This summary provides some connection to the relationship with higher order thinking skills. King and Kitchener's theory of reflective judgment sees itself as related to CT but not sharing some of the same constructs (King & Kitchener, 2004). Kuhn's theory of epistemological development makes the most direct connection between a theoretical understanding of epistemological views and CT. In an article published in 1999, Kuhn articulated a developmental model of CT which explicitly included epistemological development as one of three forms of meta-knowing cognitive skills that

she posits comprise the essential cognition required to think critically (Kuhn, 1999). Using her levels of epistemological views, she related CT to each one. Three of her four levels represent development in the late adolescent, early adult maturation period. The first level, Realist, is thought to occur in pre-school aged children and is not relevant to collegiate aged populations. The second level, Absolutist, is characterized by a domination of objective knowledge (Kuhn & Dean, 2004). At this level, students can evaluate an assertion by comparing it to what they feel is a fact to ascertain the true or false nature of the assertion. This involves some critical thought in evaluating and contrasting the current idea to an accepted fact (Kuhn, Cheney, & Weinstock, 2000). Multiplist is the third level, which is characterized by a dramatic shift to the reliance on subjective knowledge. Knowledge is seen as coming from the knower rather than an objective outside source and CT is seen as unnecessary as every idea is acceptable as knowledge and a form of truth (Kuhn & Dean, 2004). The last level, Evaluativist, utilizes both subjective and objective knowledge skillfully to compare ideas and assertions to one another and construct an evaluated knowledge base for the knower (Kuhn and Dean 2004; Kuhn et al. 2000). These categories were solidified through research using an instrument designed by Kuhn to focus on the key elements in achieving the coordination of the transition from one level to another (Kuhn et al., 2000). Table 3 provides a summary of Kuhn's theory and its relationship to CT. The connections to CT are purely theoretical and have not yet been demonstrated empirically.

Using this theory of a connection between CT and epistemological development, this study explores if this connection can be measured by examining (or correlating) student development in these areas. This empirical correlation, if it exists, will provide a

more complete picture of the best intellectual and developmental environment in which to promote CT within collegiate populations.

Table 3

Levels of Epistemological Understanding (Kuhn, 1999)

Level	Assertions	Reality	Knowledge	Critical thinking
Realist	Assertions are copies that represent an external reality.	Reality is directly knowable.	Knowledge comes from an external source and is certain.	Critical thinking is unnecessary.
Absolutist	Assertions are facts that are correct or incorrect in their representation of reality (possibility of false belief).	Reality is directly knowable.	Knowledge comes from an external source and is certain.	Critical thinking is a vehicle for comparing assertions to reality and determining their truth or falsehood.
Multiplist	Assertions are opinions freely chosen by and accountable only to their owners.	Reality is not directly knowable.	Knowledge is generated by human minds and is uncertain.	Critical thinking is irrelevant.
Evaluative	Assertions are judgments that can be evaluated and compared according to criteria of argument and evidence.	Reality is not directly knowable.	Knowledge is generated by human minds and is uncertain.	Critical thinking is valued as a vehicle that promotes sound assertions and enhances understanding.

A study done by Dings in 1989 involving college faculty members found that a large number of faculty in the study underestimated the entering epistemological development of freshman students. A large number of faculty in the study also overestimated the epistemological development of senior students, which led to their overestimation of the total effect of the collegiate experience (King & Kitchener, 1994; Scheurman, 1996). This finding is somewhat consistent with that of another group of researchers who found faculty members assume overall that college students have a higher epistemological skill level than they actually do (King et al., 1990). This misconception may frustrate attempts to use explicit instruction to teach CT skills to students who are not developmentally ready for that experience. The information

discovered in this study could assist faculty members to better inform their own pedagogical practices and knowledge of collegiate student development.

By empirically examining epistemological development in relationship to thinking critically, a richer understanding of overall student development and instructional needs could be achieved. By taking into account a student's epistemological development, issues unique to these stages could inform how to most effectively work with students to promote CT development.

Chapter Three: Methods

As discussed extensively in the literature review, it is generally thought that epistemological development and CT skills are related. This study is designed to test if such a relationship does exist. In this chapter, the research questions for the study are re-introduced followed by the study design, including a discussion of the proposed instruments. Next study participants, study site, and the role of the researcher are discussed. Information regarding perceived limitations, data collection strategies, and data analysis plans are offered.

Research Questions/Hypothesis

A leading theorist, Deanna Kuhn, offers a specific model to suggest how epistemological developmental level can influence a student's application and usage of CT skills. But there is very little empirical evidence to support a relationship between the two constructs and no direct research to support Kuhn's contention that CT skill development and usage may be shaped by specific epistemological developmental levels. This study was conceived to add to existing information regarding the CT and epistemological relationship as well as provide some initial findings as to Kuhn's proposed relationship between the two constructs.

The research questions driving this study are as follows:

1. What is the distribution of epistemological developmental levels among traditional-aged first year college students enrolled in a private, metropolitan university?

2. To what extent, if any, is there a relationship between measured CT skill development and the identified level of epistemological development in traditional-aged first-year college students enrolled in a private, metropolitan university?

Study Participants

The participants were traditionally aged students in their first year of college at a metropolitan private university. This institution is classified as a mid-sized institution with total enrollment around 9000 students. All first-year undergraduate students are enrolled in a mandatory first-year, two-semester seminar course with an average of 22 students per course. Students enrolled in these courses are limited to the age range of 17 – 20. Any student under the age of 18 were excluded from participation in the study so the age range of participants was limited to between 18 and 20 years. Eight sections out of over 60 sections of the course were used in the study. The eligible number of participants in the study was 157. One hundred and twenty-eight students completed the online CCTT, 122 students agreed to participate in the study and took the Kuhn epistemological instrument. The number of students who completed both instruments was 104.

Study Design

A quantitative, correlational research design was used. This design was selected as the intention was to identify any relationship between two constructs measured using quantitative instruments. A qualitative component, structured informational interviews, were also included. One phase was the collection and analysis of the quantitative data measuring epistemological developmental level. Another phase was the collection and analysis of the quantitative data on CT skill level of the initial, larger group of students. The purpose of these measurements was to identify the

predominant epistemological developmental level of the sample as well as to assess if there is any relationship between CT skill level and epistemological developmental level, as theorized by Kuhn. The administrations of the instruments was counterbalanced with half administered the CCTT first and the other half administered Kuhn's epistemological instrument; counterbalancing was implemented to control instrument order as a possible bias. The last phase was seven informational interviews with students who are participated in both instruments. These interviews were conducted using a structured interview guide, which is included as Appendix A.

As stated above, eight first year experience course sections at a private metropolitan university (157 students) were selected to participate in the study. At the host university's request, all eight sections were courses taught by the same faculty member. All sections were non-honors and made up of undeclared majors. This was intended to remove additional variables of honors status, which might include IQ and motivation, and course major which are not a focus of this study. Students were not required by the course professor to participate in the study. Students in the selected course sections were informed that their participation was voluntary and were presented with a consent form with relevant study information to consider and sign, if desiring to participate. The consent form is attached as Appendix C. Two individual incentives were offered by the researcher, one was a drawing for one of four \$50 gift cards for students completing the online CCTT and a \$10 Starbucks gift card for each student completing an individual interview.

The students from the selected course sections were first given either a CT instrument, the Cornell Critical Thinking Test (CCTT), in the first semester of the year-long course or the Kuhn's epistemological instrument. The same students in the same

course sections were then administered the remaining instrument, either the Kuhn's epistemological developmental survey or the CCTT. Following the completion of these two instruments, seven students agreed to complete individual interviews which contributed to the validity and reliability of the epistemological development quantitative measure. These students were selected from those students who complete the epistemological quantitative measure by soliciting participation from all students directly by the researcher and the course faculty member. This would be considered a convenience sample.

As this research is not working with vulnerable populations or with sensitive subject matter, it was only subjected to an expedited IRB review by both the researcher's institution and the research site.

Role of Researcher

The primary researcher is employed at the study site in an administrative role and has no supervisory role in the courses that were used in the study. Permission was given by the Associate Dean of Teaching and Learning and the Director of the Baccalaureate Experience to use the BAC 101 courses to recruit study subjects. The Office of Teaching and Learning funded the CT instrument, up to 150 administrations of the instrument. This support was due to a desire to encourage research on CT and inquiry learning, the QEP of the host institution, and to pilot the use of the CCTT for possible usage in their own assessment efforts. There appears to be no vested interest by either party in the findings of the research from this dissertation study.

One of the instruments was administered during scheduled course meeting times and the other was introduced in the class and then completed online. All participation

by students was voluntary. The completion of the CCTT was considered in the course grade but the individual score was not part of the student grade in the course.

Study Measures

Two primary measures were used in data collection. The first measure, the Cornell Critical Thinking Test (CCTT), was used to evaluate the CT skills of the participants. The second measure was a survey instrument created by the primary theorist in this study, Deanna Kuhn.

Critical thinking instrument – Cornell Critical Thinking Test (CCTT).

Critical thinking has many generally accepted quantitative measures available to researchers, which have extensive reliability and validity data. These instruments include the Watson-Glaser Critical Thinking Appraisal (WGCTA), the Cornell Critical Thinking Test (CCTT), the California Critical Thinking Skills Test (CCTST), and the Halpern Critical Thinking Assessment (Butler, 2012; Facione, 1990; King & Kitchener, 1994; Norris, 1985). There are also other shorter survey instruments available based on the operational definitions of these larger instruments. The CCTT, Level Z was selected for its affordability, ease of administration, and frequent usage in studies with collegiate subjects (Behar-Horenstein & Niu, 2011; Liu, Frankel, & Roohr, 2014; Verburch, Francois, Elen, & Janssen, 2013). It contains 52 forced choice items and can be administered during a standard 50-minute class period (Behar-Horenstein & Niu, 2011; Verburch et al., 2013). This test has six subscales, induction, deduction, credibility, identification of assumptions, observations, and meaning but test creators do not recommend individual scoring using subscales (Ennis, Millman, & Tomko, 2005).

Measurement of epistemological developmental level – Kuhn epistemological instrument (KEI).

One of the issues discouraging studies that examine the relationship between these two constructs may be the lack of reliable and valid quantitative measures for epistemological development.

Instruments used to measure epistemological development have traditionally been more qualitative in nature, normally taking the form of an interview, such as the Reflective Judgment Interview (RJI) (Brabeck, 1983; King & Kitchener, 2004). Qualitative methods traditionally have been undertaken more to answer a question than to build a theory, more engaged in discovery than verification (Luker, 2008). The downside of these types of measurements is that they are more complex to code and score and more labor-intensive to administer. In examining both of constructs, CT and epistemological development, using established instruments, the traditional quantitative method of CT assessment and the traditionally qualitative method of epistemological measurement sets up a mixed methods research design. Mixed method research designs are becoming more common but do have to overcome the dichotomy of research paradigms and preferences traditionally found in academic research (Johnson & Onwuegbuzie, 2004).

Based on her own four-stage operational definition of epistemological development, Kuhn created a quantitative survey for use in her own research to determine developmental level. This survey evaluated epistemological levels in five different judgement areas: personal taste, aesthetics, values, truth about the social world, and truth about the natural world (Kuhn, Cheney & Weinstock, 2000; Kuhn & Park, 2005). It created responses that allowed her to categorize each participant into a

particular developmental domain. The survey instrument asked three different questions for each area. These questions presented participants with two different opinions about a similar topic. The initial question asked each participant if only one opinion could be correct or if both could have “some rightness” (Kuhn et al., 2000). This question was designed determine if a participant had incorporated subjective knowledge into his or her own understanding of knowledge formation. If not, they were determined to be in an Absolutist stage for that area.

If the participant answered that both could be correct, they were then asked if one opinion could be “more right” than the other. This question was designed to determine if the participant had incorporated objective knowledge with subjective knowledge into his or her own definition of knowledge formation. If so, they were determined to be Evaluativists for that area. If not, they were determined to be Multiplists for that area (Kuhn et al., 2000).

In her own research, she found a variety of different types of stages by individual questions but discovered that the majority of participants in her research fell into a single developmental category (Kuhn et al., 2000). She utilized her instrument not only with college populations but also with a range of others from young children to adults and differing cultures (Kuhn et al., 2000; Kuhn & Park, 2005).

This survey has some methodological issues. While utilizing this survey in her own research, Kuhn admitted that the survey format sacrificed the “examination of many of the nuances and range of thinking about epistemological issues” (Kuhn & Park, 2005, p. 117). She cites the frequency of using interviews by researchers to measure epistemological development due to the complexity of the construct but feels that these interviews report similar findings to those found by her survey (Kuhn et al.,

2000). She does not provide any specific support for this claim. She does assert that her survey instrument has good consistency when compared to another instrument she created for research on argumentative skills, an interview-based instrument titled the Livia Problem (Kuhn et al., 2000; Kuhn & Park, 2005). There is no published validity or reliability information for her survey in any of her own research articles. To date, the survey has not been validated with one of the few other survey instruments in use, such as the Schommer Epistemological Questionnaire, which has generated a four-factor structure through exploratory and factor analyses over several studies conducted by the author (Schommer, 1990; Schommer-Aikins & Hutter, 2002). Using a relatively untested measure does present challenges. As this instrument aligns specifically with Kuhn's theoretical construct and in the absence of an alternative generally accepted quantitative measure, it was selected for use in the study.

Data Collection

Students in the sample were identified by a unique, individual number. This allowed for direct comparison of student responses on multiple instruments. This number insured that the data were kept private but it was not be anonymous. Data were collected using the CCTT cited above. It was administered during the study period, between the fourth and tenth week of the course. The administration took place electronically through Qualtrics and was introduced by the course professor. All students in each section were given access to the instrument to complete as a course assignment. Questionnaires were administered during the introduction of the CCTT to collect data on gender and high school type (public, private, senior class size, AP/IB offerings).

Table 4

Previous Studies Containing Instruments to Be Used in the Current Study

Instrument	Study	Sample	n	Reliability Evidence	Validity Evidence
Cornell Critical Thinking Test (CCTT)*					
	Myers, B. E., & Dyer, J. E. (2006). The influence of student learning style on critical thinking skill. <i>Journal of Agricultural Education</i> , 47(1), 43-52.	College students in Agriculture and Life Sciences; USA	135	Spearman-Brown and Kuder-Richardson 20 and 21 formulas reported reliability ranges from .50 to .77	NA
	Bataineh, R. F., & Zghoul, L. H. (2006). Jordanian TEFL graduate students' use of critical thinking skills (as measured by the Cornell Critical Thinking Test, Level Z). <i>International journal of bilingual education and bilingualism</i> , 9(1), 33-50.	Graduate students in M.Ed. program; Jordan	50	Reliability estimates range from 0.87 to 0.91	Reviewed by a local jury of experts from Curriculum and Instruction, Counseling and Educational Psychology, and English and approved with no modifications
Kuhn Epistemological Instrument (KEI)					
	Kuhn, D., Cheney, R., & Weinstock, M. (2000). The development of epistemological understanding. <i>Cognitive development</i> , 15(3), 309-328.	Students in 5 th (20), 8 th (25), and 12 th (21) grades as well as private university undergrads (20), community college students (20) MBA students (18), and PhD candidates (5); USA	129	NA	Developed by a content expert

Previous Studies Containing Instruments to Be Used in the Current Study

	Kuhn, D., & Park, S. H. (2005). Epistemological understanding and the development of intellectual values. <i>International Journal of Educational Research</i> , 43(3), 111-124.	Study 1: 205 middle and high school students and 209 parents; USA, Korea, and Japan Study 2: 23 high school students and 23 parents; USA	460	NA	Developed by a content expert
	Crow, W. B. (2017). <i>The domain-specificity of epistemological understanding in making aesthetic judgments</i> (Doctoral dissertation, Columbia University).**	College students taken from a private, high SES university and a public university located in New York, New York	150	NA	NA

*<https://nces.ed.gov/pubs2000/2000195.pdf> provides a fairly comprehensive compilation for the reliability and validity of the CCTT.

** The instrument used in this study is a significantly abbreviated version.

This questionnaire is attached at Appendix D. The Kuhn epistemological instrument was administered during class between the fourth and tenth week of the semester. The survey was administered by the researcher to the class and the instructor of the course was not notified regarding student failure to complete the survey.

To further assist in the establishment of reliability data for the Kuhn epistemological instrument, interviews were conducted with seven students who participated in the second portion of the study. The interview guide was constructed using questions directly from the KEI survey and was piloted with ten university students for ease of use and clarity of questions. (See Appendix A.) As the interview questions in the interview guide were taken directly from the survey instrument, in

addition to one summary question from another Kuhn study, this provided a form of test/retest reliability measures for the survey. All interview tapes were transcribed for easier evaluation. The transcription was supervised or performed by the researcher and conducted according to the established transcription guide.

Data Analysis

The study employed an exploratory data analysis using descriptive statistics for both quantitative measures, the Cornell Critical Thinking Test and the Kuhn epistemological instrument. The CCTT reports a total numerical score for the instrument. For the Kuhn epistemological instrument, each question has the possibility of three different epistemological categorical levels (absolutist, multiplist, evaluativist). The instrument is structured with five different judgement levels with three questions each. The overall developmental level was determined by a simple majority of judgement levels. If a majority cannot be determined, the student will not be considered when reporting the majority scores. The structured interviews were conducted using the instrument outlined above. Following each interview, the researcher determined an epistemological developmental level for each student based on their responses to the seven specific questions in the interviews. Transcription of all the interviews were done dictated by a specific transcription protocol.

The initial relationships between overall CT skill and epistemological development are reported using a one-way ANOVA. The dependent variable, CT, was measured using a quantitative instrument and scored on a ratio scale. The independent variable, epistemological development, was measured using a survey instrument and scored on an ordinal scale. They are reported as the effect of epistemological development on overall CT ability level using an F statistic and a level of significance set

at 0.05. This facilitates an answer to the second research question, is there a relationship between a disposition to think critically and the current level of epistemological development in first year college students. The expected outcome is that a relationship does exist between higher scores on overall CT and evaluativist levels, middle level CT scores and absolutist levels, and lower level CT and multiplist levels of epistemological development.

The discussion centers on the results as they relate to the two research questions. The data from the two questions are compared and contrasted to existing literature on both CT and epistemological development. Suggestions are made for practical applications of the information learned as well as directions for future research. With such minimal research available on the empirical relationship between CT and epistemological development, it is anticipated that such research would be valuable and contribute to the existing literature on both constructs. Comments regarding the findings about adding to the validity and reliability of the instrument to test epistemological developmental level using the Kuhn theoretical model quantitatively are included.

Limitations

There were several limitations to this study. The population of the study was drawn from one midsized private university in the southeastern United States. This singularity of location limits the external validity of the findings. Another limitation is the smaller sample size. This limitation is due to funding constrictions with the CT instrument as well as timing of the research approval.

Delimitations

A major delimitation of the study was the lack of attention paid to other variables that may affect the outcome of this study. A number of variables, such as race, socio-economic class, IQ, religion, country of origin, may affect both CT skill development and/or epistemological development and they were not considered in this study.

Chapter Four: Results

The purpose of this study was to explore the potential relationship between collegiate epistemological development and CT skills by examining differences in CT skills at different levels of epistemological development. The hypothesis of the study was that students reporting an epistemological level of either Absolutist or Evaluativist would have higher CT scores than students reporting a Multiplist level. To accurately report the results of the study, the information will be organized around the two research questions guiding the study:

1. What is the distribution of epistemological developmental levels among traditional-aged, first-year college students in a private, metropolitan university?
2. To what extent, if any, is there a relationship between measured critical thinking skill development and the identified level of epistemological development in the first-year college students enrolled in a private, metropolitan university?

Study Sample

Eight first-year experience course sections were selected for participation in the study at the private, metropolitan university, that served as the study site. These specific sections were selected by the host university for use in the study. All sections were non-honors sections, made up of undeclared majors, and taught by the same professor. All 157 students enrolled in these course sections were in their first semester of college and

between the ages of 18 and 20 years. The sample was 52% female and 48% male which is a slight over-representation of males compared to the overall campus population. All students enrolled in the eight course sections were assigned the Cornell Critical Thinking Test (CCTT) as a course assignment. One hundred and thirty-two students began the CCTT assignment and 128 completed the test. Each course section was presented the opportunity to participate in the study by the principal investigator. If a student agreed to participate, the student then signed a consent form and was administered the Kuhn epistemological survey. Four course sections were administered the Kuhn epistemological survey instrument prior to the CCTT and four course sections were administered the Kuhn survey after the CCTT administration. One hundred and twenty-six students agreed to participate in the study and 122 students successfully completed the epistemological survey.

One hundred and four students completed both the CCTT and the Kuhn epistemological survey instrument. Following the administration of both instruments, the researcher provided a course lecture on the topics of CT and epistemological development. Approximately four to six weeks later, seven individual students were interviewed employing an interview guide constructed by the principal investigator to measure epistemological development level, using information from Kuhn publications (Kuhn 1999, Kuhn et al. 2000). Both the CT presentation and the interview guide can be found in the appendices.

First Research Question

Instrument.

The Kuhn epistemological survey instrument, consisting of 15 questions, measures five different epistemological judgement domains. The survey instrument, in

its entirety, may be found in Appendix E. Three questions measure each domain level. The majority response to the three questions indicates the developmental level for that specific judgement domain. For example, if a student answered two or more questions reflecting an Absolutist developmental level for Personal Taste judgement domain, that judgement domain would reflect an assignment of Absolutist. Students whose scores reflected a different level for each of the three questions would be scored as a Multiplist, which is consistent with the scoring utilized by the survey author (Kuhn et al., 2000). In the current sample, this occurred 31 times, out of a total of scored 610 domain sections or 5% of all responses.

To examine the consistencies of responses within each judgement domain, responses were examined on the individual question level. Table 5 summarizes the response consistency for each domain section. The range of three-question consistency (students answered all three questions in a section indicating a single epistemological level) was between 39-76% over the five judgement domain levels. The range of two or more question consistency (students answered two or three questions in a section indicating a single epistemological level) was between 89 – 98%. For example, in the Personal Taste domain, 70 students answered all three questions with a singular epistemological level, or 58% of the total students in the study. Forty-five students answered two of the three questions indicating a singular epistemological level and, combined with the previous students, account for 94% of the total students in the study. Seven students answered all three questions in the section indicating different epistemological levels which brings the total percentage of students to 100.

Table 5

Consistency of Responses within Judgement Domain Section by Students Participating in the Kuhn Epistemological Survey, n=122.

Judgement Domain	Consistency	Number	Percentage
Personal Taste			
	3	70	57
	2	45	37
	0	7	6
Aesthetic Judgement			
	3	91	75
	2	29	24
	0	2	1
Value Judgement			
	3	47	39
	2	62	51
	0	13	11
Judgement about the Social World			
	3	68	56
	2	52	43
	0	2	1
Judgement about the Physical World			
	3	64	52
	2	52	43
	0	6	5

Survey results.

In Table 6, the resulting developmental level for each judgment domain as well as a predominant level for each judgement domain is reported using the mode. For the participants in this study, the Multiplist developmental level was predominant in the Personal Taste, Aesthetic Judgement, and Value Judgement domains. The Evaluativist level was predominant in the Social World Truth and Physical World Truth judgement domains.

Looking at the overall totals, the Multiplist was the majority modal level. These levels were determined by taking a simple majority of the five judgement domains. If a

student did not have a majority level (i.e., they had two Absolutist, two Multiplist, and one Evaluativist domains), they were excluded from the total.

Table 6

Results of Epistemological Developmental Level for Sample (n=122) using the Kuhn Epistemological Instrument (Kuhn et al., 2000).

Judgement Domains	Absolutist (A)	Multiplist (M)	Evaluativist (E)	Predominant Mode
Personal Taste (PT)	2	107	13	M
Aesthetic Judgment (AJ)	1	107	14	M
Value Judgment (VJ)	18	60	44	M
Social World Truth (SW)	7	55	60	E
Physical World Truth (PW)	32	37	53	E
Majority Level	2	93	27	M*

* 15 subjects were removed from this item as they did not reflect a majority level so for this item n=107.

According to Kuhn's theories examining epistemological development, the judgement domains are then combined into an overall pattern by student (Kuhn et al., 2000). These patterns are predicted to move from right to left when moving from the Absolutist to Multiplist developmental level and then from right to left when moving from Multiplist to Evaluativist. The majority pattern is indicative of the overall development level of a student. In this study, the majority pattern was found to be a MMMMM, indicating that a student reported on a Multiplist level for all five judgement domains. Table 7 contains a comparison of this study population's top five pattern results with the top five pattern results from a related study conducted by Kuhn in 2000. Kuhn's 2000 study included a wider variety of age ranges and educational experiences than the present study and did not include the Personal Taste domain so the

current study's figures have been adjusted to reflect an omission of the Personal Taste domain for the purpose of comparison. The majority pattern is consistent across both studies, but to differing degrees.

Table 7

Comparison of Top Five Predominant Patterns of Epistemological Development across Judgement Domains Comparison between Present Study (n=122) and Previous Kuhn Study (n=129) (Kuhn et al., 2000)

Pattern**	Present Study Rank	Percentage of n	Kuhn Rank	Percentage of n
MMMM	1	16	1	29
MMEE	2	12	3	9
MEEE	3	11	5	5
MMME	4	9	6	6
EEEE	5*	5	2	10

*In the present study EEEE was tied with MEEA for the fifth highest reported pattern.

** Patterns are constructed from Multiplist and Evaluativist levels along four judgement domains: Aesthetic, Values, Truth about the Social World, and Truth about the Physical World.

Kuhn et al. (2000) discussed their findings using the same instrument, which is currently the only published data set using this instrument. They detailed their findings from their undergraduate population sample with respect to judgement domains of Absolutist and Evaluativist, which were their minority levels overall, the same as the present study. In comparison to Kuhn et al.'s (2000) findings, the present study appears to have a larger percentage of student responses in the Absolutist level. Evaluativist percentages appear to be more similar. Specific findings are displayed in Table 8 below.

Tests of independence were also conducted between the five judgement domains. Only the domain pairs Social World/ Physical World and Social World/ Value Judgment were found to have a statistically significant relationship.

Table 8

Comparison of Distribution Results from the Current Sample (n=122) and Kuhn Undergraduate Sample (n=20) for Absolutist and Evaluativist Responses

	Judgment domain				
	PT	AJ	VJ	SW	PW
<i>Percentages of participants showing a predominantly absolutist level</i>					
Kuhn Sample	0	0	0	0	10
Current Sample	0	0	15	6	26
<i>Percentages of participants showing a predominantly evaluativist level</i>					
Kuhn Sample	25	25	45	45	40
Current Sample	11	11	36	49	43

Note: PT=Personal Taste, AJ=Aesthetic Judgement, VJ=Value Judgement, SW=Truth about the Social World, PW=Truth about the Physical World.

Interviews.

Seven structured interviews were also conducted with original study participants who had completed the Kuhn epistemological survey. All students in the sample were asked to participate in exchange for a gift card and seven volunteered to be interviewed. These interviews were conducted four to six weeks following the initial survey administration. These interviews were scored for epistemological developmental results, using an identical method to the survey, and then coded for thematic, qualitative data. The interview participants represented six different epistemological developmental patterns. All seven students completed the entire interview and were all considered in the study results.

Coding of the interviews reflected consistency between the student answers to the original survey questions and the explanation of their responses. One student, when responding to a question in the Aesthetic domain, explained her Multiplist response by saying, “Well, if you are talking about music then it is opinionated and one person’s opinion cannot be incorrect”. Another student explained the same response by noting,

“...there’s no facts that can back it up or maybe there might be some science study that like...certain notes are like more appealing but, like, at the same time it comes to acquired taste”.

Providing background for an Absolutist response, students identified an exterior authority and source of knowledge by stating, “...the Bible says that lying isn’t right” and “...whatever one can be backed up by scientific research...can be proven, and then it’s a fact” which is consistent with the objective and authority-based definition of the Absolutist level. With Evaluativist responses, students made comments such as, “...there is just some music that is more developed and all that” and “...I understand that sometimes people are going to lie depending on the circumstances but like lying is wrong no matter what”. This demonstrates the synthesis of both the objective and subjective components of knowledge which is a defining characteristic of the Evaluativist level. These types of responses supported the authenticity and accuracy of the students’ responses to the survey questions.

Interviews also supported the reliability of the survey results. The interview guide included six questions out of the fifteen from the original survey. The comparisons of their original survey responses with the subsequent responses during the interviews are recorded below in Table 9. This comparison was designed to provide a consistency check for the survey. As the table indicates, over half of the responses were identical with 86% either being identical or indicating a more advanced level. For example, for Subject #30, the epistemological level in question 4 changed from the original survey administration to the interview, moving from E or Evaluativist level to M or Multiplist. For question 7, the participant’s response changed from M to E. For question 8, the participant’s response was consistent with the response on the original

survey. This analysis demonstrates a 54.8% exact agreement between the initial survey and the subsequent structured interviews.

Table 9

Comparison of Kuhn Epistemological Survey Question Response to Repeated Question Response during Subsequent Interview with Seven Study Subjects. (E = evaluativist, M = multiplist, and A = absolutist)

Subject #	Q4	Int	Q7	Int	Q8	Int	Q10	Int	Q12	Int	Q13	Int
30	E	M	M	E	E	E	M	E	M	E	A	A
19	M	M	E	M	E	E	E	E	E	E	M	E
45	M	M	M	M	E	E	M	M	M	M	E	E
37	M	M	M	M	A	A	M	M	E	E	E	A
119	A	M	A	E	M	E	M	E	A	M	M	E
50	M	M	M	M	E	E	E	M	E	E	E	A
114	M	E	E	E	A	E	A	M	E	M	A	A

Note: Shading of individual cells indicates responses that moved in a regressive way.

Second Research Question

The second research question, to what extent, if any, is there a relationship between measured CT skill development and the identified level of epistemological development in the first-year college students enrolled in a private, metropolitan university, required utilization of the previously discussed survey results as well as results from the Cornell Critical Thinking Test, Level Z. The same student sample was administered a commercially-developed CT instrument, the Cornell Critical Thinking Test (CCTT). The test was administered electronically by the host institution and was a graded assignment (pass/fail based on completion) in the first-year experience course. The CCTT contains 52 multiple choice items and was scored as a total number correct. One hundred and thirty-five students registered to take the CCTT as part of their first-year experience course. One hundred and thirty-two started the instrument. Four needed to be eliminated as they had not fully completed the instrument. Later, eight

more would need to be eliminated as they did not also participate in the Kuhn epistemological instrument.

Instrument.

Using results from 128 students who completed the CCTT instrument, initial descriptive statistics were calculated. The results are displayed in Table 10. The reliability estimate using Cronbach's alpha was .554. The overall reliability figure was consistent with some of the other published administrations of this test at other undergraduate institutions but on the low end of the range published by the test manual of .49 -.80. These measures were determined using Kuder-Richardson, Spearman-Brown, and split-half reliability tests (Ennis, Millman, & Tomko, 2005). Nine CCTT questions were identified as having a negative item total correlation in the current test administration. These items were removed from the calculations which left 43 test items. The reliability was then recalculated for this data set and, using Cronbach's alpha, was .70. Removing the nine items created a second data set which could no longer be compared to other test administrations but provided higher score reliability.

The means for the original and revised administration of the CCTT, with their respective standard deviations, are displayed below in Table 10. The original, unreduced means are slightly lower than reported means from previous administrations as recorded by the CCTT manual, which ranged from 20.8 to 31.7 and other studies using the CCTT with undergraduate students (Ennis, Millman, & Tomko 2005, Iwaoka, Li, & Rhee 2010, Pierce 2011, Saeger 2014).

ANOVA results.

One-way analyses of variances (ANOVA) were conducted to compare the relationship between epistemological developmental level and CT for the study

population. This test was selected as the research question asked to compare the means of two or more groups, varying on a single dependent variable.

Table 10

Descriptive Statistics for Study Administration of the Revised Cornell Critical Thinking Test (NEW_CRIT) and the Original Cornell Critical Thinking Test (CRITICAL).

	N Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
NEW_CRIT	128	8.000	33.000	18.39063	5.553228	.437	.214	-.533	.425
CRITICAL	128	11.000	36.000	21.38281	5.060455	.466	.214	-.172	.425
Valid N (listwise)	128								

Note: The Cornell Critical Thinking Test consists of 52 questions. Nine questions with negative item-to-total correlations were removed to create a new measure.

The single independent variable was epistemological development level, and the single dependent variable was CT test score. Individual ANOVAs were calculated for the five judgement domains as well as the overall epistemological development level. These ANOVAs were calculated using both CCTT data sets. Assumptions underlying the analysis of variance were checked. There were no major violations found.

The three different overall epistemological developmental levels were compared. No significant relationship between epistemological development and CT at the $p < .05$ level were observed in the original data set, $F(2,88) = .200$, $p = 0.819$ or in the revised data set, $F(2,88) = .158$, $p = .854$ was found. Students in this study did not differ significantly in CT score based on their overall epistemological developmental level.

Tests were conducted using the judgement domains within a student's overall epistemological level. There was a significant relationship between epistemological developmental level and CT at the $p < .05$ level only for the Personal Taste judgement domain, $F(2,101) = 5.461$, $p = .006$) in both the revised CCTT data set and also in the original data set, $F(2, 101) = 6.894$, $p = .002$). The Tukey's HSD test was used to

identify the nature of the difference between the CT scores. Using the revised, more reliable CCTT data set, the analysis revealed that students reporting an Absolutist level ($M = 30.50, SD = 3.53$) scored significantly higher when compared to the Multiplist level ($M = 18.57, SD = 5.28$) and Evaluativist level ($M = 17.30, SD = 4.90$). The other two levels were not significantly different from one another. This is most likely attributed to the low number ($n = 2$) of this Absolutist group. There was not a relationship between epistemological developmental level and CT score at the $p < .05$ level for any of the other judgement domains for either of the CCTT data sets. The means and standard deviations by judgement domains for each data set are displayed below in Table 11.

Conclusions

The overall majority level of epistemological development found in this sample using the Kuhn epistemological instrument was Multiplist with a pattern of MMMMM over the five judgement domains.

The CT mean scores were reported overall as well as by epistemological level. The overall means were lower for this sample than for other reported samples using the same instrument (the CCTT) in other studies with undergraduate populations (Ennis, Millman, & Tomko 2005, Iwaoka, Li, & Rhee 2010, Pierce 2011, Saeger 2014). There was no significant difference found between CT score means by epistemological development level overall or when examined by judgement domain, with the exception of the Personal Taste domain.

Table 11

Means and Standard Deviations for the Cornell Critical Thinking Test (CCTT) by Epistemological Judgement Domain. (PT=Personal Taste, AJ=Aesthetic Judgement, VJ=Value Judgement, SW=Truth about the Social World, and PW=Truth about the Physical World)

Judgement Domains															
	PT			AJ			VJ			SW			PW		
	n	M	SD	n	M	SD	n	M	SD	n	M	SD	n	M	SD
1 st Data Set (52 questions)															
A	2	33.50	3.53	1	25.00		14	22.14	6.40	6	20.83	3.76	27	20.00	4.73
M	92	21.53	4.74	90	21.48	4.98	54	21.38	4.64	47	21.21	5.20	30	23.16	5.53
E	10	19.80	5.32	13	22.07	5.80	36	21.69	5.20	50	21.96	5.10	46	21.41	4.70
2 nd Data Set (43 questions)															
A	2	30.50	3.53	1	25.00		14	18.57	7.19	6	18.00	4.69	27	17.22	5.59
M	92	18.57	5.28	90	18.51	5.36	54	18.37	4.87	47	18.57	5.53	30	20.20	5.69
E	10	17.30	4.90	13	19.38	6.17	36	18.68	5.65	50	18.82	5.60	46	18.50	5.12

Note: A=Absolutist developmental level, M=Multiplist developmental level, and E=Evaluativist developmental level as defined by Kuhn(1999).

Chapter Five: Discussion

This study was designed to examine the relationship between CT skills and epistemological development in collegiate students. Data was gathered among first-year students enrolled in a mid-sized private university in the southeastern United States. The instruments utilized were the Kuhn epistemological instrument and the Cornell Critical Thinking Test, Level Z (Ennis, Millman, & Tomko, 2005; Kuhn et al., 2000). The two research questions guiding the study were:

1. What is the distribution of epistemological developmental levels among traditional-aged, first-year college students in a private, metropolitan university?
2. To what extent, if any, is there a relationship between measured critical thinking skill development and the identified level of epistemological development in the first-year college students enrolled in a private, metropolitan university?

Chapter Four details the descriptive findings of the data related to the two research questions. This chapter discusses the implications of the data analysis with respect to the two research questions as well as the study's limitations, recommendations for future research, and final thoughts.

Implications

Consistent with the existing literature about epistemology and collegiate populations (Perry, 1970; Kuhn et al., 2000), the majority of students' survey responses

indicated a Multiplist domain. The singularity of the epistemological level across judgement levels for the total data set was surprising, based on the wider range of student responses during the interviews, but was not inconsistent with findings from an earlier study using the same instrument (Kuhn et al., 2000). The developmental shift, predicted by Kuhn, was also consistent in this study with students moving from the MMMMM level by incorporating Evaluativist levels from the right side, or in the Judgements about the Physical and Social World prior to other judgement domains (Kuhn, 1999; Kuhn et al., 2000). The tests of independence using the epistemological data did indicate a relationship between two judgement domains, SW/PW and SW/VJ. This may be reflective of their place in the Kuhn conceptual developmental continuum. During the interviews, the students made comments reflecting the incorporation of objective, factual based information with more subjective opinion information which is consistent with these results. So, for this sample at this institution, these results indicate that the majority of students are operating from a purely Multiplist level and evolving into an Evaluativist level, beginning with more concrete topics like physical world facts and social theories.

The Multiplist ethos, that knowledge is created by human minds with assertions that are opinions freely chosen by their owners, may pose a challenge in courses where knowledge is presented as absolute or unquestionable (Kuhn, 1999; Kuhn et al, 2000; Kuhn and Dean, 2005). Students may be resistant to content that is presented as fact but not ready to participate in their own knowledge construction. Perry (1970) described the “paradox of liberal education” as students moving from a place where authorities were the gatekeepers of knowledge to being aware of competing ideas and their own active role in knowledge creation and thought. Faculty need to be prepared to

work with students on a fluidity with both the subjective and the objective nature of knowledge and assist students in their development and meta-thinking. Much of the discussion in higher education today around learning outcomes and critical thought is fairly silent on how students are coming to the academy developmentally. Standardized test scores have painted a picture of knowledge bases, primarily in math and language arts, but the measurement of developmental levels have largely been ignored. This study's finding of a majority of Multiplists entering our campuses as first-year students reinforces the necessity of collegiate professors to understand the developmental level of their incoming students and to adjust their curriculum and pedagogical techniques accordingly. Lecturing students on established research and theories may not be sufficient but engaging students in discussions and experiential learning which challenges them to compare and evaluate existing knowledge may be more productive.

Faculty also need to be cognizant of the intellectual climate of U.S. culture which encourages tolerance and diversity that may extend ideologically into a student's knowledge development. The value of reasoned argument and a search for truth or "rightness" may not be considered as significant as acceptance of others (Kuhn et al., 2000). A nuanced discussion and promotion of intentional intellectual development in this cultural environment would be productive for student populations as they consider their own cognitive practices.

The study hypothesis was that a relationship between epistemological development and CT would be demonstrated as the two constructs have been closely aligned by some theorists (Battersby, 1989; King and Kitchner, 2002; Kuhn, 1999; Kuhn et al., 2000; Siegel, 1989). Kuhn proposed the strongest, most direct connection between these two constructs by suggesting that two of the levels, Absolutist and

Evaluativist, are more likely to value and use CT skills than students in a Multiplist developmental level (Kuhn, 1999; Kuhn et al., 2000). However, this study's findings were unable to empirically demonstrate this relationship using these specific instruments and sample population. Only the Personal Taste epistemological judgement domain was found to be significantly related to CT. This domain, of the five domains, is the one postulated by Kuhn to be the least related to CT as most people do and should remain at a Multiplist level throughout their lives (Kuhn et al., 2000). This study finding may be attributed to a very small number in one of the three epistemological categories which affected the results. This study's findings also confirm a small, unpublished 2010 British report which found no relationship between overall CT ability and overall epistemological beliefs with an undergraduate student population (Hughes and Davies, 2010). It does create the question, however, if they are not directly correlated, what is their relationship?

It could be that the relationship of CT with epistemology resembles the relationship with IQ, intuitively thought to be related but not directly correlated (Butler, 2012; Halpern, 2001). It may be that epistemology is the 'theoretical core' of CT, providing the knowledge development to facilitate and fuel the higher order thinking involved in critical thought processes (Battersby, 1989). This would be consistent with philosophers who have seen CT as going beyond informal logic and incorporating a broader, more complex conceptual structure needing a foundation that does not simply employ a single type of reasoning but many other critical thought processes as well (Battersby, 1989; McPeck, 2017; Siegel, 1989). It would also be congruent with educators who cite the necessity of knowledge, both general and content, as a basis for critical thought, a tool to address ill-structured problems, and a means to generalize CT

skills over all domains and into practical, real-life applications (Butler, 2012; King and Kitchner, 2002; Kuhn 1999; Norris, 1989).

Whatever the nature of the relationship, it warrants further investigation on the collegiate level, particularly with first year students. CT appears poised to continue to be a demand of higher education and the knowledge development process requires many of the skills commonly under the CT umbrella such as meta-cognition, evaluation, observation, and inductive and deductive reasoning. Scholars such as Perry, Baxter Magolda, King, and Kitchener have done deep dives into developing knowledge creation in collegiate students. With an eye to the underlying thought processes, contemporary attention needs to be turned to this task with our entering students.

Limitations

Instruments.

The instruments employed in this study may have created some limitations for the study's results. As it is an original and non-commercial instrument, the Kuhn epistemological survey does not have published reliability and validity data available. The survey's author was solicited directly for information and cited several doctoral students which used sections of the survey in their research. These dissertation studies also failed to contain psychometric data for the instrument as they only used a portion and not the entire survey. Chi square tests of independence were conducted between each of the five judgment domains. Only two domains, PW/SW and SW/VJ, had a statistically significant relationship. This may be indicative of Kuhn's theory of how this development is occurring but the expectation, if that were true, would have been a similar relationship found between VJ/AJ and AJ/PT which was not detected.

But the interviews conducted following the original survey administration did provide evidence of consistency and/or growth between identical questions included in both administrations. The analysis of the items within each section of the instrument also indicated consistency within section questions. Further research using this measure for comparison and examination of convergent relationships with other instruments would be helpful to increase confidence in its usage. Replication of this study with another epistemological instrument may also add some validity evidence for this instrument. Cognitive interviewing may also be another way to validate this survey

The CT instrument, the CCTT, also provided some limitations. The instrument contained some scenerios that referenced topics that are currently considered controversial. The topic, rather than the underlying thought process, may have affected the individual student responses, depending on their sensitivity to these topics. Updating the instrument to remove current “hot button” topics may increase the overall reliability and validity of the instrument.

The initial reliability of the sample was low (.554), and nine items had to be eliminated to bring the reliability to a more acceptable level (.70). Examining the low instrument reliability in a larger perspective, however, places the potential reliability of testing CT skills in a familiar place.

Constructing quality CT instruments is complex and this challenge is recognized by numerous theorists and researchers (Butler, 2012; Ennis, 1993; Halpern, 2001; Liu et al., 2014). Halpern, who has constructed her own instrument to measure CT skills, the Halpern Critical Thinking Assessment (HCTA), described the task in this way, “The only thing that is easy about this undertaking is that it is easy to see that assessing outcomes that result from critical thinking is fraught with multiple measurement and logistical

problems and decisions” (Halpern, 2001, p. 277). Issues cited with CT measures are many. The lack of a consistent, operational definition of CT and the multiple cognitive skills and processes that are represented by the term CT make crafting a single instrument to measure the totality of CT difficult. The reduced validity and significant time invested in psychometric testing when using multiple choice instruments and conversely the decreased reliability and time-consuming scoring of open-ended or performance instruments makes deciding on a preferred or recommended format problematic. Additionally, the differences in beliefs and assumptions between test authors and test takers, as well as the challenge of balancing the authenticity of the instrument with psychometric quality round out a formidable list of challenges(Ennis, 1993; Halpern, 2001; Liu et al., 2014).

The advantages of using a commercially-available product, the increased amount of psychometric information available from multiple studies and the opportunity for comparison and generalization, outweighed other concerns when selecting the instrument for this particular study. While the reliability was on the lower end of their previously published range, this study’s scores remain consistent with earlier findings and adds some generalizability to the findings that would not be available from a newly created or more narrowly focused measure (Ennis, Millman, & Tomko, 2005). This instrument appears to have been an effective choice for this study.

Timing of presentation.

A presentation was given to all eight course sections used on critical thinking following the test and survey administration but prior to the individual interviews. The content presented in that presentation may have affected the students’ responses during the interviews which may have appeared to increase the reliability of the Kuhn

epistemological instrument. In two instances, students repeated direct examples given in the presentation back to the researcher during the interview. The presentation should have been scheduled after the interviews to more accurately measure the students' existing critical thinking skill and epistemological developmental level.

Sample.

This was a small, convenience sample taken from a single, mid-sized private university. To gain a fuller understanding if any relationship exists between these two constructs, a larger, multi-institutional study would be needed. This sample also limited examination of additional demographic data such as major, GPA, and specific college enrollment as it was not a representative sample. The timing of the administration may also have been an issue for the sample. The CCTT, Level Z was designed for advanced/gifted high school or college students. As this test was administered during their first semester of attendance, it may have been too advanced for the current CT skill set of this sample.

Recommendations for Future Research

The specific connection between CT and epistemological development has been largely unexplored empirically. The theoretical assumption that there is a relationship between these two constructs was not supported by this study. This was not an expected finding. Specifically, data collected using Kuhn's epistemological survey did not support her theoretical relationship between CT and epistemological development. Replications of this study would add more clarification to this initial study and to the value of the findings. If further studies to support this initial empirical finding, this could and should have important impacts on the existing assumptions around this relationship.

As instruments may have been a limitation of this study, further research investigating this relationship using different instruments is warranted. Varying instrument use would add to both the understanding of the value of the instruments used in this study through possible triangulation of results as well as examining the relationship through different definitions, as each instrument may be based on differing definitions of both epistemology and CT. A broader and larger sample would add a greater understanding of the relationship between these two constructs by examining a more diverse group of undergraduate students.

This study did not address the variables of gender, citizenship, and/or ethnicity. These variables may have significant impacts on one or both of these constructs at this level. For example, gender has been identified as an important variable in epistemological development but it is unknown if it also may affect a potential relationship with critical thinking (Belenky, Clinchy, Goldberger, & Tarule, 1986).

Investigations into constructing more reliable CT instruments could also be beneficial to all research aimed at measuring these skills. In 2014, the Educational Testing Service (ETS) acknowledged the challenge in evaluating these skills despite a high demand for exactly such an instrument but, to date, has yet to produce an instrument (Liu et al., 2014). As CT continues to be a stated objective of most higher education institutions, better measurement tools can and should be a priority.

Final Thoughts

The skills of intellectual development, whether they be epistemological or higher order thinking skills, have largely been overlooked in curricular, pedagogical, and evaluation educational materials and activities. High-stakes testing and federal policies based on knowledge acquisition in the K-12 arena have created an environment where

intellectual developmental processes are all but discouraged. This presents a unique challenge to collegiate environments to change not only the level of educational rigor but also the manner and foci as well. Many institutions are meeting the challenge by putting an emphasis on inquiry learning, experiential learning, cooperative learning and internship programs, and undergraduate research to help expose students to higher order thinking and knowledge development skills. While this is laudable and encouraging, the support and training for faculty members need to also accompany these programs. Many faculty members may not understand how to facilitate and incorporate intentional strategies into their courses that can encourage this type of development in their students. This can be particularly challenging in fields like accounting and chemistry that have fewer ill-structured problems to provide some natural development in these areas.

This study's intent was to find a possible relationship between epistemological development and CT as a means to provide a scaffold for faculty to build from epistemological development to CT. As the relationship seems to be more nuanced than previously hypothesized, new ways to encourage these constructs in classrooms and educational programs will still need to be explored. It is hoped that this study can contribute some value and evidence to assist others as they pursue these ends.

References

- Abrami, P. C., Bernard, R. M., Borokhovski, E., Wade, A., Surkes, M. A., Tamim, R., & Zhang, D. (2008). Instructional interventions affecting critical thinking skills and dispositions: A stage 1 meta-analysis. *Review of Educational Research, 78*(4), 1102-1134.
- Arum, R., & Roksa, J. (2011). *Academically adrift: Limited learning on college campuses*. Chicago, IL: University of Chicago Press.
- Battersby, M. (1989). Critical thinking as applied epistemology: Relocating critical thinking in the philosophical landscape. *Informal Logic, 11*(2), 91-100.
- Baxter Magolda, M. B. (2004). Evolution of a constructivist conceptualization of epistemological reflection. *Educational Psychologist, 39*(1), 31-42.
- Behar-Horenstein, L. S., & Niu, L. (2011). Teaching critical thinking skills in higher education: A review of the literature. *Journal of College Teaching and Learning, 8*(2), 25.
- Belenky, M. F., Clinchy, B. M., Goldberger, N. R., & Tarule, J. M. (1986). *Women's ways of knowing: The development of self, voice, and mind* (Vol. 15). New York: Basic Books.
- Belkin, D. (2017, June 5). Exclusive test data: Many colleges fail to improve critical-thinking skills. *The Wall Street Journal Eastern Edition*. Retrieved from <https://www.wsj.com/articles/exclusive-test-data-many-colleges-fail-to-improve-critical-thinking-skills-1496686662>.

Berliner, D. C., & Glass, G. V. (Eds.). (2014). *50 myths and lies that threaten America's public schools: The real crisis in education*. New York: Teachers College Press.

Brabeck, M. M. (1983). Critical thinking skills and reflective judgment development: Redefining the aims of higher education. *Journal of Applied Developmental Psychology, 4*(1), 23-34.

Burbules, N. C., & Berk, R. (1999). Critical thinking and critical pedagogy: Relations, differences, and limits. In T. Popkewitz & L. Fendler (Eds.), *Critical theories in education: Changing terrains of knowledge and politics* (pp.45-65). Retrieved from

<https://books.google.com/books?hl=en&lr=&id=1RiBAAAAQBAJ&oi=fnd&pg=PA45&dq=Critical+thinking+and+critical+pedagogy:+Relations,+differences,+and+limits&ots=ZtczwwL4gp&sig=Tne5cdTcMbVko4CrtKnA76dbpGI#v=onepage&q=Critical%20thinking%20and%20critical%20pedagogy%3A%20Relations%2C%20differences%2C%20and%20limits&f=false>

Butler, H. A. (2012). Halpern Critical Thinking Assessment Predicts Real-World Outcomes of Critical Thinking. *Applied Cognitive Psychology, 26*(5), 721-729.

Butler, J., & Spivak, G. C. (2001). What is critique?. *Concern, 30*(2), 225-248.

Cizek, G. J., Bowen, D., & Church, K. (2010). Sources of validity evidence for educational and psychological tests: A follow-up study. *Educational and Psychological Measurement, 70*(5), 732-743.

Council for Aid to Education. (2017). *College Sample Assessment*. Retrieved from http://cae.org/images/uploads/pdf/CLA_Practice_Assessment.pdf

Creswell, J. W., & Clark, V. P. (2018). *Designing and Conducting Mixed Methods Research*. Thousand Oaks, CA: Sage Publications.

- Crow, W. B. (2017). *The domain-specificity of epistemological understanding in making aesthetic judgments* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global (10255718)
- Daniel, M., & Auriac, E. (2011). Philosophy, Critical Thinking and Philosophy for Children. *Educational Philosophy and Theory*, 43(5), 415-435.
- DeAngelo, L., Hurtado, S., Pryor, J. H., Kelly, K. R., Santos, J. L., & Korn, W. S. (2009). The American college teacher: National norms for the 2007-2008 HERI faculty survey. *Los Angeles: Higher Education Research Institute, UCLA*.
- Ennis, R. H. (1993). Critical thinking assessment. *Theory Into Practice*, 32(3), 179-186.
- Erwin, T. D. (1983). The scale of intellectual development: Measuring Perry's scheme. *Journal of College Student Personnel*, 24(1), 6-12.
- Facione, P. A. (1990). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction. Research findings and recommendations*. Retrieved from <https://files.eric.ed.gov/fulltext/ED315423.pdf>
- Facione, P. A., Sánchez, C. A., Facione, N. C., & Gainen, J. (1995). The disposition toward critical thinking. *The Journal of General Education*, 44(1), 1-25.
- Facione, P. A. (2011). Critical thinking: What it is and why it counts. *Insight Assessment*, 2007(1), 1-23.
- Finn Jr, C. E. (1990). The biggest reform of all. *Phi Delta Kappan*, 71(8), 584-592.
- Freire, P. (1996). *Pedagogy of the oppressed (revised)*. New York, NY: Continuum.

- Halpern, D. F. (1998). Teaching critical thinking for transfer across domains: Disposition, skills, structure training, and metacognitive monitoring. *American Psychologist*, 53(4), 449.
- Halpern, D.F. (1999). Teaching for critical thinking: Helping college students develop the skills and dispositions of a critical thinker. *New Directions for Teaching and Learning*,(80), 69-74.
- Hanley, G. L. (1995). Teaching critical thinking: Focusing on metacognitive skills and problem solving. *Teaching of Psychology*, 22(1), 68-72.
- Hirsch Jr, E. D., Kett, J. F., & Trefil, J. S. (1988). *Cultural literacy: What every American needs to know*. Boston, MA: Houghton Mifflin.
- Hirsch Jr, E. D. (2016). *Why knowledge matters: Rescuing our children from failed educational theories*. Cambridge, MA: Harvard Educational Press.
- Hofer, B. K. (1994). Epistemological Beliefs and First-Year College Students: Motivation and Cognition in Different Instructional Contexts. Retrieved from <http://ezproxy.lib.usf.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=ED379567&site=eds-live>.
- Hofer, B. K., & Pintrich, P. R. (1997). The development of epistemological theories: Beliefs about knowledge and knowing and their relation to learning. *Review of Educational Research*, 67(1), 88-140.
- Huber, C. R., & Kuncel, N. R. (2016). Does college teach critical thinking? A meta-analysis. *Review of Educational Research*, 86(2), 431-468.
- Huitt, W. (1998). Critical thinking: An overview. *Educational Psychology Interactive*. Retrieved from <http://www.edpsycinteractive.org/topics/cogsys/critthnk.html>.

- Ivankova, N. V., Creswell, J. W., & Stick, S. L. (2006). Using mixed-methods sequential explanatory design: From theory to practice. *Field Methods*, 18(1), 3-20.
- Iwaoka, W. T., Li, Y., & Rhee, W. Y. (2010). Measuring gains in critical thinking in food science and human nutrition courses: The Cornell Critical Thinking Test, problem-based learning activities, and the student journal entries. *Journal of Food Science Education*, (3), 68
- Jenkins, R. (2017, March 23). Why college graduates still can't think [The James G. Martin Center for Academic Renewal]. Retrieved from <https://www.jamesgmartin.center/2017/03/college-graduates-still-cant-think/>
- Johnson, R. B., & Onwuegbuzie, A. J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7), 14-26.
- King, P. M., & Kitchener, K. S. (1994). *Developing reflective judgment: Understanding and promoting intellectual growth and critical thinking in adolescents and adults*. San Francisco, CA: Jossey Bass.
- King, P. M., & Kitchener, K. S. (2004). Reflective judgment: Theory and research on the development of epistemic assumptions through adulthood. *Educational Psychologist*, 39(1), 5-18.
- King, P. M., Wood, P. K., & Mines, R. A. (1990). Critical thinking among college and graduate students. *The Review of Higher Education*, 13(2), 167.
- Korn, M. (2014, October 21). Bosses seek "critical thinking," but what is that? *The Wall Street Journal*. Retrieved from <https://www.wsj.com/articles/bosses-seek-critical-thinking-but-what-is-that-1413923730>.
- Ku, K. Y., & Ho, I. T. (2010). Dispositional factors predicting Chinese students' critical thinking performance. *Personality and Individual Differences*, 48(1), 54-58.

- Kuhn, D. (1999). A developmental model of critical thinking. *Educational Researcher*, 28(2), 16-46.
- Kuhn, D., Cheney, R., & Weinstock, M. (2000). The development of epistemological understanding. *Cognitive Development*, 15(3), 309-328.
- Kuhn, D., & Dean, D. (2004). Metacognition: A bridge between cognitive psychology and educational practice. *Theory Into Practice*, 43(4), 268-273.
- Kuhn, D., & Park, S. H. (2005). Epistemological understanding and the development of intellectual values. *International Journal of Educational Research*, 43(3), 111-124.
- Lai, E. R. (2011). Critical thinking: A literature review. *Pearson's Research Reports*, 6, 40-41.
- Li, Y., & Kettinger, W. J. (2006). An evolutionary information-processing theory of knowledge creation. *Journal of the Association for Information Systems*, 7(9), 25.
- Locker, S. (2006). *The influence of adolescents' developing epistemological understanding and theories of intelligence on their aspirations* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (305359465).
- Liu, O. L., Frankel, L., & Roohr, K. C. (2014). Assessing Critical Thinking in Higher Education: Current State and Directions for Next-Generation Assessment. *ETS Research Report Series*, 2014(1), 1-23.
- Luker, K. (2008). *Salsa dancing into the social sciences*. Cambridge, MA: Harvard University Press.

- Magno, C. (2010). The role of metacognitive skills in developing critical thinking. *Metacognition and Learning, 5*(2), 137-156.
- Marin, L. M., & Halpern, D. F. (2011). Pedagogy for developing critical thinking in adolescents: Explicit instruction produces greatest gains. *Thinking Skills and Creativity, 6*(1), 1-13.
- McPeck, J. E. (2017). *Teaching critical thinking: Dialogue and dialectic*. London; New York: Routledge.
- Miller, P. H. (2011). *Theories of developmental psychology*. New York, NY: Worth Publishers.
- Mines, R. A., King, P. M., Hood, A. B., & Wood, P. K. (1990). Stages of intellectual development and associated critical thinking skills in college students. *Journal of College Student Development, 31*(6), 538-547.
- Miri, B., David, B. C., & Uri, Z. (2007). Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking. *Research in Science Education, 37*(4), 353-369.
- Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research, 40*(2), 120-123.
- Myers, B. E., & Dyer, J. E. (2006). The influence of student learning style on critical thinking skill. *Journal of Agricultural Education, 47*(1), 43.
- Norris, S. P. (1985). Synthesis of research on critical thinking. *Educational Leadership, 42*(8), 40-45.
- Niu, L., Behar-Horenstein, L. S., & Garvan, C. W. (2013). Do instructional interventions influence college students' critical thinking skills? A meta-analysis. *Educational Research Review, 9*, 114-128.

- Pascarella, E. T., & Terenzini, P. T. (2005). *How college affects students: A third decade of research. Volume 2*. San Francisco, CA: Jossey-Bass.
- Pascarella, E. T., & Blaich, C. (2013). Lessons from the Wabash National Study of Liberal Arts Education. *Change: The Magazine of Higher Learning*, 45(2), 6-15.
- Paulsen, M. B., & Feldman, K. A. (2005). The conditional and interaction effects of epistemological beliefs on the self-regulated learning of college students: Motivational strategies. *Research in Higher Education*, 46(7), 731-768.
- Perry, W. G., & Harvard University. (1970). *Forms of intellectual and ethical development in the college years: A scheme*. New York: Holt, Rinehart and Winston, Inc.
- Perry, W. G. (1999). *Forms of ethical and intellectual development in the college years: A scheme*. New York, NY: Holt, Rinehart and Winston, Inc.
- Piaget, J. (1971). *Psychology and epistemology* (A. Rosin, trans.). New York, NY: Grossman.
- Pierce, T. (2011). *Introductory computer programming courses used as a catalyst to critical thinking development*. Retrieved from ProQuest Dissertations & Theses Global. (916617376).
- Ravitch, D. (1983). *The troubled crusade: American education, 1945-1980*. New York: Basic Books.
- Ravitch, D. (2016). *The death and life of the great American school system: How testing and choice are undermining education*. New York, NY: Basic Books.
- Saeger, K. J. (2014). The development of critical thinking skills in undergraduate students. *Culminating Projects in Higher Education Administration*, 1, http://repository.stcloudstate.edu/hied_etds/1.

- Scheurman, G. (1996, April). *Faculty members' assumptions about college students' reasoning*. Paper presented at the annual meeting of the American Educational Research Association, New York, NY.
- Schoen, L., & Fusarelli, L. D. (2008). Innovation, NCLB, and the fear factor: The challenge of leading 21st-century schools in an era of accountability. *Educational Policy, 22*(1), 181-203.
- Schommer, M. (1990). Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology, 82*(3), 498.
- Schommer-Aikins, M., & Hutter, R. (2002). Epistemological beliefs and thinking about everyday controversial issues. *The Journal of Psychology, 136*(1), 5-20.
- Shim, W. J., & Walczak, K. (2012). The impact of faculty teaching practices on the development of students' critical thinking skills. *International Journal of Teaching and Learning in Higher Education, 24*(1), 16-30.
- Sloane, F. C., & Kelly, A. E. (2003). Issues in high-stakes testing programs. *Theory into Practice, 42*(1), 12-17.
- Steinke, P., & Fitch, P. (2007). Assessing service-learning. *Research & Practice in Assessment, 2*. Retrieved from <https://files.eric.ed.gov/fulltext/EJ1062690.pdf>.
- Sternberg, R. J. (1986). *Critical thinking: Its nature, measurement, and improvement*. Retrieved from <https://files.eric.ed.gov/fulltext/ED272882.pdf>.
- Terenzini, P. T., Springer, L., Pascarella, E. T., & Nora, A. (1995). Influences affecting the development of students' critical thinking skills. *Research in Higher Education, 36*(1), 23-39.
- Tsui, L. (2000). Effects of campus culture on students' critical thinking. *The Review of Higher Education, 23*(4), 421-441.

- van Gelder, T. (2005). Teaching critical thinking: Some lessons from cognitive science. *College Teaching*, 53(1), 41-48.
- Verburgh, A., François, S., Elen, J., & Janssen, R. (2013). The Assessment of Critical Thinking Critically Assessed in Higher Education: A Validation Study of the CCTT and the HCTA. *Education Research International*, 2013.
- West, E. J. (2004). Perry's legacy: Models of epistemological development. *Journal of Adult Development*, 11(2), 61-70.
- West, R. F., Toplak, M. E., & Stanovich, K. E. (2008). Heuristics and biases as measures of critical thinking: Associations with cognitive ability and thinking dispositions. *Journal of Educational Psychology*, 100(4), 930-941.
- Wilén, W. W., & Phillips, J. A. (1995). Teaching critical thinking: A metacognitive approach. *Social Education*, 59(3), 135-38.
- Zhang, Z., & RiCharde, R. S. (1998, April). *Assessing college students' development: A repeated-measures analysis using a mixed model*. Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Appendix A:

Interview Guide

Introduction

I am a student in the College of Education at the University of South Florida. I am piloting a research study for my dissertation designed to measure different ways of knowing or epistemological developmental. Ways of knowing basically refers to how a person determines for himself or herself what is true or figuring out how to decide what we know and why. I am interested in all your responses and thoughts; there are no right or wrong answers.

This interview will take about 20 minutes. We can stop any time. Your participation is voluntary and anything you say will be kept confidential. Because what you have to say is so important, I would like to tape record our interview. Is that all right?

For our records, please state if it is all right to tape record the interview.

Thank you. I am going to take notes as we talk, so I don't forget anything important. Is that all right?
Do you have any questions?

Interview Guide Questions

Opening Questions

1. Why did you select the University of Tampa to attend? Tell me about your experience to this point?
2. Have your classes challenged you to examine your own personal beliefs to this point? Have you had the opportunity to challenge or consider the beliefs of others in class? Please explain your responses.

Key Questions

I am going to now give you a series of similar but different situations. I am going to ask you to respond to them using two of the same questions and then ask you to explain your answers. Is that okay?

1. Robin thinks the first piece of music they listen to is better. Chris thinks the second piece of music they listen to is better. Can only one of their views be right, or could both have some rightness? If both could have some rightness, could one view be better or

more right than the others? Could you explain your choices? (Aesthetic judgment)

2. Robin thinks lying is wrong. Chris thinks lying is permissible in certain situations. Can only one of their views be right, or could both have some rightness? If both could have some rightness, could one view be better or more right than the others? Could you explain your choices? (Value judgments)
3. Robin thinks people should take responsibility for themselves. Chris thinks people should work together to take care of each other. Can only one of their views be right, or could both have some rightness? If both could have some rightness, could one view be better or more right than the others? Could you explain your choices? (Value judgments)
4. Robin agrees with one book's explanation of how children learn language. Chris agrees with another book's explanation of how children learn language. Can only one of their views be right, or could both have some rightness? If both could have some rightness, could one view be better or more right than the others? Could you explain your choices? (Judgments of truth about the social world)
5. Robin has one view of why criminals keep going back to crime. Chris has a different view of why criminals keep going back to crime. Can only one of their views be right, or could both have some rightness? If both could have some rightness, could one view be better or more right than the others? Could you explain your choices? (Judgments of truth about the social world)
6. Robin believes that one book's explanation of what atoms are made up of. Chris believes another book's explanation of what atoms are made up of. Can only one of their views be right, or could both have some rightness? If both could have some rightness, could one view be better or more right than the others? Could you explain your choices? (Judgments of truth about the physical world)
7. Many social issues, like the death penalty, gun control, or health care, are mostly matters of personal opinion and there is no basis for saying that one person's opinion is better than another's. So, there is not much point in people having discussions about these kinds of issues. Do you strongly agree, sort of agree, or disagree? Can you explain how you came to that conclusion? (Multiplist v. Evaluativist)








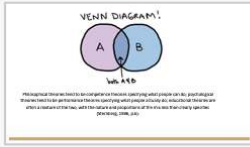
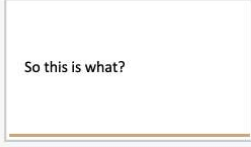
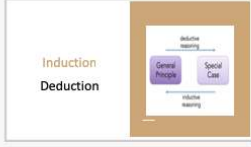



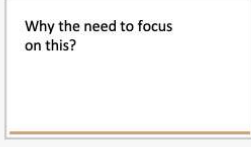






Closing Questions

1. In making the decisions about the questions above, what role did facts and evidence play? Where would you find facts and evidence? Are these good tools in making decisions? How do you use them?

If the opening questions did not capture the desired demographic data (gender, country of origin, major), direct demographic questions should also be included in closing questions.

Appendix B: Critical Thinking Presentation Slides

This presentation was done following the administration of the Kuhn epistemological instrument (KEI) or two weeks after the administration of the KEI, depending on the section.

 <p>1</p>	 <p>2</p>	 <p>3</p>	 <p>4</p>
 <p>5</p>	 <p>6</p>	 <p>7</p>	 <p>8</p>
 <p>9</p>	 <p>10</p>	 <p>11</p>	 <p>12</p>
 <p>13</p>	 <p>14</p>	 <p>15</p>	 <p>16</p>
 <p>17</p>	 <p>18</p>	 <p>19</p>	 <p>20</p>

Attachment C:
IRB Approval Letter and Informed Consent Form



RESEARCH INTEGRITY AND COMPLIANCE
Institutional Review Boards, FWA No. 00001669
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799
(813) 974-5638 • FAX (813) 974-7091

August 21, 2018

Mary Margaret Wertz
Educational and Psychological Studies Tampa, FL 33612

RE: Expedited Approval for Initial Review

IRB#: Pro00036319

Title: Epistemological Developmental Level and Critical Thinking Skill Level among Undergraduate University Students

Study Approval Period: 8/21/2018 to 8/21/2019

Dear Ms. Wertz:

On 8/21/2018, the Institutional Review Board (IRB) reviewed and **APPROVED** the above application and all documents contained within, including those outlined below.

Approved Item(s):

Protocol Document(s): [Protocol, Version #1, 7/30/18](#)

Consent/Assent Document(s)*:

[DISS UT Student Consent, Version #1, 8.6.18.docx.pdf](#)

*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent documents are valid until the consent document is amended and approved.

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110. The research proposed in this study is categorized under the following expedited review category:

- (5) Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for nonresearch purposes (such as medical treatment or diagnosis).
- (6) Collection of data from voice, video, digital, or image recordings made for research purposes.
- (7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) business days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

Kristen Salomon, Ph.D., Chairperson USF Institutional Review Board



Informed Consent to Participate in Research Involving Minimal Risk

Pro # 00036319

You are being asked to take part in a research study. Research studies include only people who choose to take part. This document is called an informed consent form. Please read this information carefully and take your time making your decision. Ask the researcher or study staff to discuss this consent form with you, please ask him/her to explain any words or information you do not clearly understand. The nature of the study, risks, inconveniences, discomforts, and other important information about the study are listed below.

We are asking you to take part in a research study called:
Epistemological Developmental Level and Critical Thinking Skill Level in Undergraduate University Students.

The person who is in charge of this research study is **Monnie Huston Wertz**. This person is called the Principal Investigator. However, other research staff may be involved and can act on behalf of the person in charge. She is being guided in this research by **Dr. Barbara Shircliffe and Dr. Jim King**.

The research will be conducted at The University of Tampa.

Purpose of the study

This purpose of this study is to understand if a correlation exists between critical thinking skills and epistemological development in college students. For this study, critical thinking is defined as "... reasonable reflective thinking focused on deciding what to believe or do" (Ennis, 1993, p. 180). Epistemological development is defined in terms of the theories presented by Dr. Deanna Kuhn as, "the coordination of the subjective and objective dimensions of knowing" (Kuhn, et al., 2000, p. 310).

Methods of inquiry will be two quantitative instruments, one measuring critical thinking skills, the other measuring epistemological development. The outcome would be to determine if a relationship between these two constructs exists in collegiate students.

Why are you being asked to take part?

We are asking you to take part in this research study because you are qualified to take part in this research as a first-year student over the age of 18 enrolled in a mandatory first-year experience course at the University of Tampa and the information you provide will be very important to our research.

Study Procedures:

If you take part in this study, you will be asked to complete two quantitative instruments as well as a demographic survey. The first instrument is the Cornell Critical Thinking Skills test which is being administered to all students in the selected sections by the Office of Undergraduate Research at the University of Tampa. Your permission is needed to access your data from this instrument. The second instrument, an epistemological development survey, is being administered by the primary investigator. Fifteen students will be able to participate in an additional interview, following the completion of the two quantitative instruments to be selected from a convenience sample, lasting approximately 15-20 minutes. Students who completed the epistemological quantitative instrument will be contacted via email in November to solicit participation in the interviews and selected on a first-come, first-serve basis. These interviews will be recorded, they will be identified only with your participant number, and will be maintained for 5 years following the submission of the Final Report to the IRB. They will then be deleted from the secure server on which they are stored.

Total Number of Participants

About 160 individuals will take part in this study at the University of Tampa.

Alternatives / Voluntary Participation / Withdrawal

You should only take part in this study if you want to volunteer. Your decision to participate or not to participate will not affect your student status, course grade, recommendations, or access to future courses or training opportunities. You should not feel that there is any pressure to take part in the study. You are free to participate in this research or withdraw at any time. You may refuse to answer questions that you do not wish to answer. There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study. The study should take a total of ten minutes of your time completing a quantitative instrument in class. You are also granting permission for the researcher to have access to your score on the Cornell Critical Thinking Test, which is administered as part of your BAC 101 course.

Benefits

The potential benefits of participating in this research study include a measurement of your own critical thinking skill level and epistemological developmental level as well as providing assistance in developing better methods of developing critical thinking skills in collegiate students and improving collegiate pedagogical techniques to that end.

Risks or Discomfort

This research is considered to be minimal risk. That means that the risks associated with this study are the same as what you face every day. There are no known additional risks to those who take part in this study.

Compensation

The first, 50th, 100th, and 150th Kuhn epistemological instruments scored will be eligible for one of four \$50 VISA gift cards. Students who agree to post-survey interviews (15 will be selected using a convenience sample) will be given a \$10 Starbucks gift card.

Privacy and Confidentiality

We will keep your study records private and confidential. Certain people may need to see your study records. Anyone who looks at your records must keep them confidential. These individuals include:

- The research team, including the Principal Investigator and study supervisor.
- Certain government and university people who need to know more about the study, and individuals who provide oversight to ensure that we are doing the study in the right way.
- Any agency of the federal, state, or local government that regulates this research.
- The USF Institutional Review Board (IRB) and related staff who have oversight responsibilities for this study, including staff in USF Research Integrity and Compliance.

We may publish what we learn from this study. If we do, we will not include your name. We will not publish anything that would let people know who you are. Aggregated data may be shared with the Center for Teaching and Learning at UT for the purpose of evaluating the instruments used in the study.

You can get the answers to your questions, concerns, or complaints

If you have any questions, concerns or complaints about this study, or experience an unanticipated problem, please contact the principle investigator, Monnie Wertz. She may be contacted at mhwertz@ut.edu or by calling (813) 257-3757 with any questions or concerns about the research study.

If you have questions about your rights as a participant in this study, or have complaints, concerns or issues you want to discuss with someone outside the research, call the USF IRB at (813) 974-5638.

While we are conducting the research study, we cannot let you see or copy the research information we have about you. After the research is completed, you have a right to see the information about you, as allowed by USF policies. You will receive a signed copy of this form.

You can get the answers to your questions, concerns, or complaints

If you have any questions, concerns or complaints about this study, or experience an

unanticipated problem, call Monnie Huston Wertz at 813-257-3757.

If you have questions about your rights as a participant in this study, or have complaints, concerns or issues you want to discuss with someone outside the research, call the USF IRB at (813) 974-5638 or contact by email at RSCH-IRB@usf.edu.

Consent to Take Part in this Research Study

I freely give my consent to take part in this study I understand that by signing this form I am agreeing to take part in research. I also affirm that I am over 18 years of age. I have received a copy of this form to take with me.

Signature of Person Taking Part in Study

Date

Printed Name of Person Taking Part in Study

Statement of Person Obtaining Informed Consent

I have carefully explained to the person taking part in the study what he or she can expect from their participation. I confirm that this research subject speaks the language that was used to explain this research and is receiving an informed consent form in their primary language. This research subject has provided legally effective informed consent.

Signature of Person obtaining Informed Consent

Date

Printed Name of Person Obtaining Informed Consent

Appendix D:

Student Demographic Collection Form

Subject Demographic Collection Form

Student ID # _____
Student Subject # _____

Thank you for responding to these inquiries accurately. These reflect the demographic information most of interest for the current study. They do not reflect the totality of demographic variables which may affect the outcome of the study.

1. Please circle the gender with which you best identify:

Male Female Transgender Rather not respond

2. Please circle all the appropriate descriptors of your high school experience:

Public Private Religiously-affiliated

3. Please indicate the size of your graduating class: _____

4. Please indicate the number of AP courses you took in high school: _____

5. Please indicate if you took college courses as part of your high school program (i.e. dual enrollment): Yes _____ No _____

6. Please indicate if you were enrolled in an International Baccalaureate (IB) in your high school: Yes _____ No _____

Appendix E:

KUHN SURVEY INSTRUMENT (2000)

Student ID # _____ Student Subject # _____

Instructions: Students are to read each set of statements and answer the two subsequent questions.

Judgments of personal taste

1. Robin says warm summer days are nicest. Chris says cool autumn days are nicest.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT

BOTH COULD HAVE SOME RIGHTNESS

(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT

ONE COULD NOT BE MORE RIGHT THAN THE OTHER

(circle one)

2. Robin says the stew is spicy. Chris says the stew is not spicy at all.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT

BOTH COULD HAVE SOME RIGHTNESS

(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT

ONE COULD NOT BE MORE RIGHT THAN THE OTHER

(circle one)

3. Robin thinks weddings should be held in the afternoon. Chris thinks weddings should be held in the evening.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT

BOTH COULD HAVE SOME RIGHTNESS

(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT

ONE COULD NOT BE MORE RIGHT THAN THE OTHER

(circle one)

Aesthetic judgments

4. Robin thinks the first piece of music they listen to is better. Chris thinks the second piece of music they listen to is better.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT

BOTH COULD HAVE SOME RIGHTNESS

(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT
ONE COULD NOT BE MORE RIGHT THAN THE OTHER
(circle one)

5. Robin thinks the first painting they look at is better. Chris thinks the second painting they look at is better.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT
BOTH COULD HAVE SOME RIGHTNESS
(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT
ONE COULD NOT BE MORE RIGHT THAN THE OTHER
(circle one)

6. Robin thinks the first book they both read is better. Chris thinks the second book they both read is better.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT
BOTH COULD HAVE SOME RIGHTNESS
(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT
ONE COULD NOT BE MORE RIGHT THAN THE OTHER
(circle one)

Value judgments

7. Robin thinks people should take responsibility for themselves. Chris thinks people should work together to take care of each other.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT
BOTH COULD HAVE SOME RIGHTNESS
(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT
ONE COULD NOT BE MORE RIGHT THAN THE OTHER
(circle one)

8. Robin thinks lying is wrong. Chris thinks lying is permissible in certain situations.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT
BOTH COULD HAVE SOME RIGHTNESS
(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT

ONE COULD NOT BE MORE RIGHT THAN THE OTHER
(circle one)

9. Robin thinks the government should limit the number of children families are allowed to have to keep the population from getting too big. Chris thinks families should have as many children as they choose.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT
BOTH COULD HAVE SOME RIGHTNESS
(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT
ONE COULD NOT BE MORE RIGHT THAN THE OTHER
(circle one)

Judgments of truth about the social world

10. Robin has one view of why criminals keep going back to crime. Chris has a different view of why criminals keep going back to crime.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT
BOTH COULD HAVE SOME RIGHTNESS
(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT
ONE COULD NOT BE MORE RIGHT THAN THE OTHER
(circle one)

11. Robin thinks one book's explanation of why the Crimean wars began is right. Chris thinks another book's explanation of why the Crimean wars began is right.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT
BOTH COULD HAVE SOME RIGHTNESS
(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT
ONE COULD NOT BE MORE RIGHT THAN THE OTHER
(circle one)

12. Robin agrees with one book's explanation of how children learn language. Chris agrees with another book's explanation of how children learn language.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT
BOTH COULD HAVE SOME RIGHTNESS
(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT
ONE COULD NOT BE MORE RIGHT THAN THE OTHER
(circle one)

Judgments of truth about the physical world

13. Robin believes one book's explanation of what atoms are made up of. Chris believes another book's explanation of what atoms are made up of.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT

BOTH COULD HAVE SOME RIGHTNESS

(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT

ONE COULD NOT BE MORE RIGHT THAN THE OTHER

(circle one)

14. Robin believes one book's explanation of how the brain works. Chris believes another book's explanation of how the brain works.

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT

BOTH COULD HAVE SOME RIGHTNESS

(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT

ONE COULD NOT BE MORE RIGHT THAN THE OTHER

(circle one)

15. Robin believes one mathematician's proof of the math formula is right. Chris believes another mathematician's proof of the math formula is right

Can only one of their views be right, or could both have some rightness?

ONLY ONE RIGHT

BOTH COULD HAVE SOME RIGHTNESS

(circle one)

If both could be right, could one view be better or more right than the other?

ONE COULD BE MORE RIGHT

ONE COULD NOT BE MORE RIGHT THAN THE OTHER

(circle one)

Kuhn, D., Cheney, R., & Weinstock, M. (2000). The development of epistemological understanding. *Cognitive development*, 15(3), 309-328 used with permission of the author.