DEFINING INTELLECTUAL CURIOSITY
IN HIGHER EDUCATION

by

Nancy Lea Bridier

M.A., The University of West Florida, 1999

B.A., The University of West Florida, 1996

A dissertation submitted to the Department of Research and Advanced Studies
College of Education and Professional Studies
The University of West Florida
In partial fulfillment of the requirements for the degree of
Doctor of Education

2016
The dissertation of Nancy Lea Bridier is approved:

Diane P. Bagwell, Ed. D., Committee Member Date

Byron C. Havard, Ph.D., Committee Member Date

Joyce C. Nichols, Ed. D., Committee Member Date

Carla J. Thompson, Ed. D., Committee Chair Date

Accepted for the Department/Division:

Francis E. Godwyll, Ph.D., Chair Date

Accepted for the University:

John Clune, Ph.D., Interim AVP for Academic Programs Date
ACKNOWLEDGMENTS

There are a number of people I would like to thank for their support during the time of my research. To Dr. Carla Thompson, my committee Chair, I would like to express my appreciation for her mentorship and wisdom throughout my doctoral journey. You have fueled my passion for research and statistics by giving me so many opportunities to excel. I would also like to thank my committee members: Dr. Diane Bagwell, Dr. Byron Havard, and Dr. Joyce Nichols. I would like to first thank Dr. Diane Bagwell for her motivational and emotional support during the dissertation process. I would also like to thank Dr. Byron Havard for bringing so many students together during Thursday night sessions and making our concerns seem relevant by offering his time and encouragement. Lastly, I would like to thank Dr. Joyce Nichols for always offering genuine kindness and support.

Many friends have assisted me along the doctoral journey. I would like to acknowledge Joshua Schutts for his expert guidance in learning new statistical software. I would like to express my gratitude to my dear friends and UWF classmates: Jennifer Whatley, Susan Barnes, Charles Charlton, and Shumon Islam. We have made it through so much together and it has been a pleasure sharing the experiences with you. I will always treasure our friendships.

I wish to express my love and appreciation to my wonderful husband, Jay, who not only supported me through late nights and tears, but also assisted in tirelessly entering mounds of raw data. No other husband in the world would show such dedication. I would also like to thank my beautiful daughter, Savana, for assisting me with data collection and once again inspiring me with a topic for research. The time of hearing, “I’m sorry, I have to work on my dissertation” is over - thank you for your patience. Lastly, I would like to thank my Dad. You taught me to explore, ask questions, and always look up.
# TABLE OF CONTENTS

ACKNOWLEDGMENTS ........................................................................................................ iv  
LIST OF TABLES .................................................................................................................. vii  
LIST OF FIGURES ............................................................................................................... viii  
ABSTRACT ............................................................................................................................ ix  

CHAPTER I. INTRODUCTION ............................................................................................... 1  
A. Background of the Study ......................................................................................... 2  
B. Overview of Theoretical Framework ................................................................... 3  
C. Theory of Integration for Study Framework ......................................................... 11  
D. Statement of the Problem ...................................................................................... 14  
E. Purpose of the Study .............................................................................................. 15  
F. Rational for the Study ............................................................................................. 15  
G. Research Question ................................................................................................. 16  
H. Definition of Terms ................................................................................................. 17  
I. Chapter Summary ....................................................................................................... 19  

CHAPTER II. LITERATURE REVIEW ................................................................................... 20  
A. Historical Overview of Curiosity ......................................................................... 21  
B. Historical Overview of Intelligence ..................................................................... 25  
C. Theoretical Framework Development ................................................................ 28  
D. Theory of Intelligence ........................................................................................... 29  
E. Theory of Curiosity ............................................................................................... 37  
F. Theory Integration .................................................................................................. 40  
G. Related Literature ................................................................................................... 41  
H. Defining Intellectual Curiosity ............................................................................... 48  
I. Chapter Summary ....................................................................................................... 50  

CHAPTER III. METHODOLOGY .......................................................................................... 52  
A. Research Question ................................................................................................. 52  
B. Research Design ...................................................................................................... 52  
C. Participants ............................................................................................................. 53  
D. Data Collection and Procedures ......................................................................... 53  
E. Sampling .................................................................................................................. 54  
F. Permissions ............................................................................................................. 54  
G. Instrumentation ....................................................................................................... 54  
H. Data Analysis .......................................................................................................... 58  
I. Chapter Summary ....................................................................................................... 58  

CHAPTER IV. RESULTS ...................................................................................................... 60  
A. Resulting Demographics for the Sample ............................................................... 60  
B. Data Screening .............................................................................................................62
C. Review of Instrumentation..........................................................................................63
D. Quantitative Analyses ...............................................................................................64
E. Conceptual Definition of Intellectual Curiosity.......................................................83
F. Research Question .....................................................................................................84
G. Chapter Summary .....................................................................................................85

CHAPTER V. CONCLUSION..........................................................................................87
A. Summary of Research ................................................................................................87
B. Discussion of the Findings..........................................................................................88
C. Conceptual Definitions ..............................................................................................94
D. Limitations of the Study ..........................................................................................96
E. Implications of the Study .........................................................................................96
F. Future Research .......................................................................................................98
G. Chapter Summary .....................................................................................................100

REFERENCES .............................................................................................................102

APPENDICES ............................................................................................................121
A. Survey and Informed Consent .................................................................................122
B. Institutional Review Board Approval Letter .........................................................128
C. Letter of Permission to use Curiosity and Exploration Inventory .......................130
D. Letter of Permission to use Need for Cognition Scale ......................................132
E. Letter of Permission to use Big Five Inventory ....................................................134
F. Curiosity and Exploration Inventory (CEI-II) .........................................................136
G. Need for Cognition Scale (NCS) ..........................................................................138
H. Big Five Inventory (BFI) ........................................................................................140
LIST OF TABLES

1. Convergent Validity Coefficients for the TDA, NEO, and BFI ........................................ 57

2. Resulting Demographics of Study Participants and the Existing Regional University Demographics ................................................................................................................. 61

3. Means and Standard Deviations for Scores on the NCS and the Subscales for the CEI-II and BFI ...................................................................................................................... 65

4. Summary of Intercorrelations for Scores on the NCS and the Subscales for the CEI-II and BFI ........................................................................................................................................ 66

5. Factor Loadings for Exploratory Factor Analysis with Oblique Rotation of BFI, CEI-II, and the NCS ................................................................................................................................... 70

6. Fit Indices for Exploratory Factor Models of the Measure of Intellectual Curiosity ........ 76

7. Factor Correlations ...................................................................................................................... 78


9. Items Eliminated as a Result of EFA .......................................................................................... 80

10. Identification of Intellectual Curiosity in Literature .................................................................. 83
LIST OF FIGURES

1. Integrated theoretical framework of Cattell’s theory of intelligence and Berlyne’s theory of curiosity ...........................................12

2. Theoretical framework integrating theories of Cattell and Berlyne ................................29

3. Reinforcing cycle of curiosity ..................................................................................38

4. Scree plot of eigenvalues produced by Mplus .........................................................69
ABSTRACT

DEFINING INTELLECTUAL CURIOSITY
IN HIGHER EDUCATION

Nancy Lea Bridier

Over the past five years, the term *intellectual curiosity* has been used more often in the fields of research, education, and employment. As college admissions and the job market become more competitive, many universities and employers are stressing the demonstration of intellectual curiosity as a determining factor in admission and hiring decisions. To this date, the term lacks empirical definition. The current study focuses on establishing a sound framework for developing a foundation for exploring the term intellectual curiosity and examines the interrelationships among variables generated by the framework. The rationale for this study is to offer a definition of intellectual curiosity to assist educators with identifying student characteristics that demonstrate the term based on the theoretical perspectives of Cattell (1943, 1957) and Berlyne (1960). This study integrated the theory of curiosity with the investment theory to propose a framework for exploring the factor structure of intellectual curiosity.

Undergraduate students completed three survey instruments measuring curiosity and exploration, the need for cognition, and the big five factors of personality. A factor analytic approach was used to explore the factor structure of intellectual curiosity and align that structure with the speculated conceptual definitions of intellectual curiosity found in the current literature. The factor analysis and conceptual alignment findings were integrated to identify an empirical definition for intellectual curiosity. Current study findings support an empirical definition of intellectual curiosity that encompasses intellectual engagement, seeking new information through exploration, a desire to engage in and understand the world, conscientiousness, and openness to
new ideas and experiences. Research implications of these findings include the potential for further theory development and the potential for measures of intellectual curiosity for classroom and research purposes. Implications for practice include the potential for assisting college administrators and employers with research based decisions regarding admissions, recruitment, and hiring processes. The field of education may benefit from the study’s findings with the potential for stimulating the intellectual curiosity within faculty, influencing teaching practices, and enriching students’ learning. Suggestions for future research are also addressed.
CHAPTER I
INTRODUCTION

The subject of curiosity has been acknowledged throughout history in literature, mythology, philosophy, and research. Curiosity has driven the search for knowledge whether that knowledge satisfies the arousal of inner conflict or imparts wisdom to the individual to then share with humanity. The literal definition of curiosity is still not without some controversy and a term used sporadically in the 20th century, but becoming more prevalent in the last decade is *intellectual curiosity*. From an educational and research perspective, curiosity is the desire for knowledge (Aristotle 350 B. C./1941; Berlyne, 1960; Dewey, 1910; Loewenstein, 1994). Speculations suggest intellectual curiosity encompasses attitude, drive, cognitive outcomes, critical thinking, intellect, and motivation. Although used in the fields of research, education, and employment, the term intellectual curiosity has yet to be empirically defined. This may be problematic since institutions of higher education are requiring the demonstration of intellectual curiosity for admission decisions such as University of Chicago, Saba University School of Medicine, Stanford, Princeton, Boston College, University of Iowa, University of Miami, University of Missouri, University of North Florida (Honors Program), and the University of Georgia, just to name a few.

The current study focuses on establishing a sound framework for developing a foundation for exploring the term, “intellectual curiosity,” and examines the interrelationships among variables generated by the framework. Variables such as curiosity, thinking, and intellectual engagement will encompass the effort delineated by the framework development. Procedures were outlined in an effort to develop an empirical definition of intellectual curiosity.
The rationale for this study is to offer a definition of intellectual curiosity to assist educators with identifying student characteristics that demonstrate the term based on the perspective of the framework developed in the study as suggested by Cattell (1943, 1987) and Berlyne (1954, 1960). Data obtained from this study may assist in supporting the theoretical constructs of Berlyne and Cattell and the integration of these two theorists’ perspectives for the purpose of empirically examining and validating the interrelationships of curiosity and intellectual engagement. A concise, empirical definition of intellectual curiosity may also provide a research-based decision-making process regarding a student’s drive to be successful in a program of higher education. Chapter I is divided into the following sections: Background, Theoretical Framework, Problem Statement, Purpose of the Study, Rationale for the Study, Research Questions, Chapter Summary, and Definitions of Terms.

**Background of the Study**

Historically there were two waves of curiosity research: The period between the 1950s to 1960s focused on determining the underlying causes of curiosity, its constructs, and development of a theory (Berlyne, 1954, 1960). During the 1960s and 1970s timeframe, much of the curiosity research was focused on exploratory behavior and the challenge of measuring curiosity (Langevin, 1971), developing instruments for measuring curiosity in elementary school children (Maw & Maw, 1964), measuring sensation seeking (Zuckerman, Kolin, Price, & Zoob, 1964), measuring exploration within the framework of personality (Fiske, 1966), measuring curiosity in relation to intrinsic motivation (Day, 1969, 1971), and the development of state-trait measures which considered curiosity as a transitory state (Spielberger & Starr, 1994). A resurgence in curiosity research occurred in the late 1990s and into the 21st century with the consideration of curiosity and exploration relative to anxiety, depression, learning, and new, more succinct
methods of measurement (Beswick, 2004; Byman, 2005; Derrick et al., 2007; Litman, 2005; Loewenstein, 1994). In addition, researchers were beginning to examine curiosity in the workforce environment (Harvey, Novicevic, Leonard, & Payne, 2007; Mussel, 2012; Mussel et al., 2012). This study focuses on the 1950-60 curiosity research efforts as the baseline for the development of a framework for the investigation and the 1990s to current research because of the extensive literature and sound empirical evidence afforded the literature from the late 20th century to 2013. Among the various historical debates concerning curiosity is the question of whether curiosity is a drive, state, trait, or motivational impetus. For the purpose of this study, curiosity is defined by Berlyne (1978) as “an internal state occasioned when subjective uncertainty generates a tendency to engage in exploratory behavior aimed at resolving or partially mitigating the uncertainty” (p. 98).

**Overview of Theoretical Framework**

Two theoretical models were integrated to develop the framework necessary to connect the constructs of intellect and curiosity. Raymond Cattell’s (1943, 1987) theory of intelligence forms the foundation of the theoretical framework for this study by establishing the structure of intelligence and its interaction with personality. Cattell emphasizes two types of intelligence: fluid and crystallized, which will be discussed further in the next section. Daniel Berlyne’s (1949, 1954, 1960) theory of curiosity, more specifically epistemic curiosity, builds on Cattell’s factor analytic work focused on providing evidence of individual differences. With regard to individual differences, Berlyne (1960) noted Cattell’s (1957) factor analyses have indicated “an ‘erg’ or drive, varying in prevailing strength from one individual to another, that he [Cattell] calls *exploration (curiosity)*” (p. 282). Berlyne also acknowledged Cattell’s discovery of the significantly positive correlation of drive with the personality traits of sensitivity and openness.
Berlyne (1960) interpreted Cattell’s findings to “clearly be concerned with epistemic behavior in particular” (p. 282). The tenets of each of the theories of Cattell and Berlyne will be discussed in the following sections.

**Theory of intelligence.** Cattell began his career as a graduate assistant for Charles Spearman (1929), researching the measurement of adult intelligence. Spearman (1904a) determined the following conjecture: A common source of variance accounted for the correlations among all mental tests as well as other measures of mental ability, which he called the general factor (g; pp. 255-268). Cattell (1943) recognized a dearth of formal definitions of intelligence and the methods by which intelligence was measured. Although by 1943 “no fewer than 44” (Cattell, 1943, p. 153) intelligence tests were being used in the government and educational systems, these tests lacked validation efforts and consistency. Cattell’s (1943, 1963) contention was to promote the use of factor analysis, particularly in the United States, to validate current methods of intelligence testing and empirically define intelligence. Although Cattell (1943, 1963) supported Spearman’s biologically founded general factor, he suspected cultural experiences also influenced intellectual abilities. An individual’s exposure to “intensive educational efforts” (Cattell, 1987, p. 339) may affect an increase in Intelligence Quotient (IQ) by a few points, but is not effectual on “general intelligence” (Cattell, 1987, p. 340). With each of these considerations in mind, Cattell (1943) hypothesized two factors of intelligence or adult mental capacity: “fluid ability (g_f) and crystallized ability (g_c)” (p. 178). These two abilities or mental capacities became known as two different intelligences referred to as fluid intelligence and crystalized intelligence spearheaded by Cattell in 1943. In addition, these two new terms focused on types of intelligence with each consisting of two different sets of abilities (Cattell,
The abilities comprising fluid intelligence and crystallized intelligence are discussed in the following sections.

**Fluid intelligence.** Cattell (1943) defined fluid intelligence as having “the character of a purely general ability to discriminate and perceive relations between any fundamentals, new or old. It [fluid ability within individuals] increases until adolescence and then slowly declines” (p. 178). This fluidity is not tied to any specific habits or sensorimotor functions, but the individual’s fluidity is based on biological factors and is related to a person’s ability to learn and solve problems. Fluid abilities comprising fluid intelligence are exemplified as conceptual or perceptual reasoning, spatial relations, abstract relations in numbers, and inferential relations (Cattell, 1987, p. 115). Fluid intelligence involves many processes functioning simultaneously and “is an expression of the level of complexity of relationships which an individual can perceive and act upon when he does not have recourse to answers to such complex issues already stored in memory” (Cattell, 1987, p. 115).

Prior to reaching biological maturity (15 to 20 years of age) individual differences are reflected in “cultural opportunity and interest” (Cattell, 1963, p. 3). Differences among adults are reflected in age because of the gap between \( g_c \) and \( g_t \) increases “with experience and the time decay of \( g_t \)” (Cattell, 1963, p. 3). Typically, crystallized and fluid intelligence begin developing simultaneously at birth and continue at a steady increase until young adulthood (approximately age 25) when fluid intelligence peaks and then begins to decline as indicated by the decline of basic information processing abilities in the elderly. While fluid intelligence loses acuteness, crystallized intelligence continues to increase well into adulthood, evidenced as cultural knowledge and pragmatic thinking; this creates a gap between \( g_c \) and \( g_t \) (Cattell, 1963, 1987).
**Crystallized intelligence.** Cattell (1943) described crystallized intelligence as consisting of “discriminatory habits long established in a particular field, originally through the operation of fluid ability, but not *sic* longer requiring insightful perception for their successful operation” (p. 178). The term crystallized reflects the application of verbal conceptual knowledge or concrete operations based on learned experiences through the investment of fluid intelligence in cultural settings. In other words, crystallized abilities are typically acquired in classroom or educational settings, are culturally dependent, and help form habitual judgment responses. Crystallized abilities comprising crystallized intelligence are exemplified by general reasoning, verbal performance, recognition, factual knowledge, grammar, and computation (Cattell, 1987). Although crystallized intelligence continues to increase across the lifespan, it will begin to decline in old age, but at a much slower rate than fluid intelligence (Cattell, 1943).

Cattell (1987) later termed the intelligence theory an *investment theory* of intelligence, in which “crystallized ability becomes the trustee of gains from investment by fluid ability” (p. 120). Although representative of a hierarchical model of intelligence, Cattell’s investment theory of intelligence is based on factor analytic techniques. At the time (1987), Cattell unequivocally argued the non-existence of empirical evidence to support a hierarchical structure for the investment theory of intelligence; however, one of Cattell’s students (Carroll, 1993, 2003) introduced a hierarchical structure for the investment theory of intelligence later. Cattell (1943) suggested individual differences in intellectual performance at different points in time and under different circumstances indicate the need for two different measures. Two different measures will more reliably predict intelligence as opposed to basing determination on only one measure (Cattell, 1943).
Theory of personality. Cattell (1943) later simultaneously focused on defining the basic constructs of personality, which he termed “traits” (p. 561). According to Cattell, an individual’s personality offers a glimpse of what that individual will do in a particular situation. Through the exploration of traits, researchers are able to understand the structure, function of personality, and predict behaviors (Cattell, 1950, 1957, 1987).

Traits. Cattell (1957, 1987) categorized traits through the process of factor analysis to consist of surface and source traits. Surface traits represent observable personality characteristics correlating or clustering together to form the more “useful” source trait (Cattell, 1957, p. 17). Examples of surface traits include traits of individuals who have an interest in widely diverse topics, a willingness to experience new things and/or meet new people, and an enjoyment of solving puzzles. These surface traits are indicative of the source trait labeled openness. Source traits are considered as individual factors or patterns of behavior attributed to a single source and represent the underlying structure of personality (Cattell, 1957, 1987). Through the application of factor analysis, Cattell (1957) determined the existence of 16 source traits or primary factors of personality (16PF). A discussion of the three types of data, observational, self-report, and objective assessment used for Cattell’s (1957) research of personality traits occurs in Chapter II. Of these 16 source traits, there were three trait dimensions: Temperament Traits, Ability Traits, and Dynamic Traits (1957). Each of these three traits is discussed in subsequent sections relative to Cattell’s work in this arena.

Temperament traits. Cattell (1957) considered temperament to be a biologically based facet of an individual’s personality capable of modification by environmental influences such as parenting, peers, or therapy. Temperament traits are demonstrated by behaviors such as aggression, excitability, emotional stability, and sensitivity.
**Ability traits.** Cattell (1957, 1987) considered ability traits reflective of an individual’s propensity for dealing with complex problem solving situations, such as insight, creativity, or adaptation. Ability traits are measured by speed or meagerness of errors in performance (Cattell, 1957). Depending on the performance measure, ability traits can reflect fluid and/or crystallized intelligence.

**Dynamic traits.** Dynamic traits refer to traits related to a person’s motivations originating from the drives or needs an individual seeks to satisfy (Cattell, 1965). Within dynamic traits are sentiments, or environmental influences consisting of a pattern of learned attitudes. Sentiments or attitudes tend to emerge from focusing on an important aspect of a person’s life such as a focus on spouse, or religion, or career. Sentiments can be unlearned when no longer needed. For example, a person’s behavior or attitude may be influenced by religious beliefs or by a spouse or family member, but as the individual grows intellectually or emotionally, his or her attitude may change resulting in actions such as divorce or changes in religious views. Cattell (1965) also suggested another term, “ergs,” as influencing dynamic traits, thereby influencing a person’s behavior. Cattell’s (1957) term “erg” is defined as “an innate reactivity toward a goal, though stimuli and means are learned” (p. 628). Cattell (1957) used the term “erg” rather than the term, “drive” because Cattell believed the term “drive” lacked operational precision (p. 520). Cattell (1957) posited the term “erg” was more “demonstrable by factor analytic proof of functional unity in attitude action courses toward a common goal” (p. 543). One of the 11 types of ergs discussed by Cattell is the term “curiosity.” The terms curiosity and exploration are used synonymously by Cattell (1957) to indicate the following meaning “To see, to read, to know, to listen, to learn, to satisfy curiosity—about quite a number of things” (p. 516).
Interaction of intelligence and personality. Cattell described a “complex interaction between intelligence and personality” (Boyle, Stankov, & Cattell, 1995, p. 5) and suggested both are interpreted as enduring traits (Cattell, 1987). Cattell’s (1987) fervent stance was “personality factors over and above intelligence contribute” (p. 464) to accurate achievement prediction. These intellectual investment traits are related to an individual’s desire for knowledge (Cattell, 1943, 1971).

Theory of curiosity. Curiosity is often described as a “drive to know” (Berlyne, 1954, p. 187) or desire for knowledge (Aristotle 350 B. C./1941; Berlyne, 1954, 1960; Collins, Litman, & Spielberger, 2004; Litman & Spielberger, 2003; Loewenstein, 1994). Daniel Berlyne is considered by many to be the father of curiosity (Day, 1982, p. 19; Reio, 2008a, p. 126; Reio, 2008b, p. 3; Rotto, 1994, p. 737). Berlyne (1950) describes the human instinct of curiosity as “active striving to encounter new experiences, and to assimilate and understand them when encountered, underlies a huge variety of activities highly esteemed by society…” (p. 68). Berlyne (1960) developed specific terms to describe curiosity as a drive caused by conflicting stimuli with four specific types of curiosity: “perceptual” (p. 195), “specific, diversive,” (p. 80) and “epistemic” (p. 265).

Perceptual curiosity. According to Berlyne (1954, 1960), perceptual curiosity is defined as “states of high arousal that can be relieved by specific exploration” (p. 195). Berlyne posited the following: Perceptual curiosity can affect any of the five senses, such as an infant hearing the sound of a new toy followed by the curious child’s exploration and manipulation of the toy. As an adult, perceptual curiosity may be exemplified as the following scenario: An individual may overhear part of a conversation between two people and approach them in order to learn more about the topic. Often referred to in current literature (Aluja-Fabregat, 2000; Litman, 2005;
Zuckerman & Little, 1986) as morbid curiosity, an individual may be drawn to a crowd of people or the scene of an accident in an effort to find out more information.

**Specific curiosity.** The seeking of specific information based on a gap in one’s knowledge in an attempt to reduce conflict is described by Berlyne (1960) as specific curiosity (p. 80). Berlyne (1963) describes the process of curiosity and exploration as having a reinforcing function because of the initial conflict, “the psychological function of information is to reduce conflict” (p. 324). An example of specific curiosity is a student presented with a course assignment on an unfamiliar topic begins to search online for specific information regarding the topic in hope of expanding the knowledge base (and passing the course).

**Diversive curiosity.** Although perceptual and specific curiosities are cued in response to a stimulus or increase in arousal, diversive curiosity is triggered by boredom and a need for stimulation (Berlyne, 1960, p. 80). This type of curiosity is exemplified as the following: People “surfing” the internet for any type of information, game, movie to pass the time.

**Epistemic curiosity.** The primary focus of the current study is epistemic curiosity, described as a desire for knowledge arising as the result of conflict between beliefs, attitudes, or thoughts (Berlyne, 1962). Berlyne (1962) described epistemic curiosity as “a motivational state (a state of high drive or arousal) that actuates quests for knowledge and is relieved by acquisition of knowledge” (p. 27). Epistemic curiosity is exemplified by a student’s desire for deeper understanding of a topic and seeking information beyond what may be required for an assignment or course. Berlyne (1960, 1963, 1965) described the action of seeking out information as exploratory behavior. The purpose of exploratory behavior is to intensify the stimulation without discernable biological implications. Berlyne (1965) also used the term
intrinsic to describe exploratory behavior because the behavior fulfills an inner desire and reduces feeling of conflict rather than fulfilling a biological need.

Theory Integration for Study Framework

The purpose of this study was to utilize the theory of intellect derived primarily from Cattell (1943, 1957, 1963, 1987) and the theory of curiosity derived primarily from Berlyne (1954, 1960). Although the theory of intellect from Cattell and the theory of curiosity from Berlyne are distinctly different, the theories are conceptually related as discussed in the previous sections of this Chapter I and are essential to the formalization of the term intellectual curiosity. This study focuses on the utilization of the integration of these two theories in the development of a strong foundational base for approaching the theoretical and empirical analyses of the term, intellectual curiosity, in an effort to discover a sound definition for researchers and practitioners. The integration of the two theories of intelligence (Cattell, 1943, 1987) and curiosity (Berlyne, 1954, 1960) is depicted in Figure 1 with extensive discussion. As indicated in Figure 1, Cattell’s theory of intelligence and Berlyne’s theory of curiosity have commonalities within the constructs and variables associated with each theory.
Beginning with the common element of *drive*, both Cattell and Berlyne posited the existence of an instinctual drive, referred to by Cattell (1957, p. 520) as *erg* and by Berlyne (1954, p. 181) as *curiosity drive*. Cattell’s notion of an exploration or curiosity erg, as represented by a desire for knowledge, also identified by Berlyne as a parallel between the concept of drive and the concept of intelligence (Berlyne, 1960, 1967). Berlyne’s description of a curiosity drive included exploration or exploratory behavior to seek new information aligning with the perspective posited by Cattell. A reinforcing function of curiosity was explained by both Cattell and Berlyne. Curiosity is stimulated by a feeling of arousal (Berlyne, 1954, 1960), or ergic tension (Cattell, 1957) caused by an individual’s realization of a conflictive gap in one’s knowledge. This curiosity is evidenced by the individual’s engagement in exploratory or information seeking behavior. Once information is gained, the conflict is reduced. The entire
process of stimulation, search for information, and reduction of conflict is reinforcing and therefore the person is more likely to engage in this process when met with similar circumstances, such as an information gap or uncertainty of information. For example, a student may attend the dissertation defense of a peer and presented with unfamiliar information so intriguing, the student feels the need for further investigation of the topic. The student will engage in exploratory behavior, such as thinking about the stimulus of information presented and where to locate additional information, as well as consulting other sources such as libraries, talking with other professionals, or web searches. Once more information is gained, the student may have a feeling of satisfaction from having obtained additional information to process what was heard during the presentation. The information seeking followed by the feeling of satisfaction is a reinforcing process possibly leading the student to further investigate the information for possible dissertation research.

The curiosity drive posited within Berlyne’s theory of curiosity variables of thinking, observing, and consulting behaviors relate to Cattell’s proposition of being comprised of intelligence and personality characteristics. The integration of constructs from each of the two theories (intelligence and curiosity) is necessary to develop a framework for determining intellectual curiosity. Figure 1 illustrates the constructs and variables within the nomological network of Cattell’s theory of intelligence and Berlyne’s theory of curiosity. Berlyne’s theory of curiosity described an individual’s psychophysiological state at a given point in time, but failed to consider the impact of personality characteristics. With the inclusion of Cattell’s investment theory, the two theories come together as depicted in Figure 1 to support the variables of thinking, exploration and knowledge seeking, consultation, and intellectual engagement; variables posited in this study to contribute to the identification of intellectual curiosity.
Statement of the Problem

Two areas of focus align with the statement of the problem: (1) a practitioner focus and (2) a researcher focus. Practitioners or educators in higher education fields have suggested a strong need for the definition and measure of intellectual curiosity as demonstrated in the following discussion. Researchers interested in determining a theoretical and empirical definition for intellectual curiosity have expressed a strong interest in a foundational and statistical basis for moving forward with this endeavor as suggested in the following discussion.

Practitioner need. An online search of admission criteria yields universities’ and colleges’ preference for students’ demonstration of intellectual curiosity. In addition, many institutions are considering test optional admissions, which is admission not based on SAT or ACT scores. The National Association for College Admission Counseling (NACAC) reports admission trends since 2003 indicate only 59% of institutions surveyed rated test scores as “considerably important” in the admission decision process; more often test scores may be used for placement decisions (Hurley, Clinedinst, & Hawkins, 2011). In a 13 year longitudinal study, Adelman (1999) found only 23% of bachelor degree attainment could be predicted from test scores. Institutions such as Wake Forest University (2015) support the test optional criteria for admission decisions, with a statement from the university’s Dean of Admissions stating, “The students that we seek are those that... are going beyond expectations and exhibiting real motivation and intellectual curiosity” (Allman, 2015; “Top Ten Admissions Questions,” para. 2).

Researcher need. Few researchers have focused empirical attention to the study of intellectual curiosity, its definition, or method of measurement. While some researchers (Cyr, 1996; Russell, 2013; von Stumm & Ackerman, 2013; von Stumm, Hell, & Chamorro-Premuzic, 2011) have discussed intellectual curiosity, the term does not have an operational definition or a
valid method of measurement. Additional research studies highlighted in Chapter II provide substantial evidence for the need for the study.

**Purpose of the Study**

The purpose of this study was to identify and establish a definition of intellectual curiosity generated by the strong framework established for the study and empirically driven by examining the interrelationships between curiosity, thinking, and intellectual engagement as defined by Cattell (1943, 1957, 1987) and Berlyne (1954, 1960, 1962). A shared, empirical definition of intellectual curiosity assists researchers with further investigating the internal structure of the construct, and developing measures to predict an individual’s future success in higher education and the workforce.

**Rationale for the Study**

The current study contributes to the body of knowledge and extends the research continuum by establishing a definition of intellectual curiosity as a foundation for further research and practical use in education and the job market. Much of the current literature discusses the lack of definition and speculates intellectual curiosity’s theoretical components. This study may not only assist subsequent research efforts, but may allow higher education institutions to better understand intellectual curiosity, its importance for both faculty and students, and how to stimulate and sustain intellectual curiosity in today’s technological learning environments.

Because many institutions of higher education are including intellectual curiosity as a desirable student attribute for admission, an operational definition of intellectual curiosity is needed toward the long-term goal of establishing an objective system for predicting academic success. According to Peggy Maki (2002) at the American Association for Higher Education and
Accreditation (AAHEA), institutional commitment to assessing student learning necessitates colleges and universities “establish principles of inquiry that emerge from and are sustained by faculty intellectual curiosity” (p. 4). However, without a concrete multidisciplinary definition of intellectual curiosity, it is difficult to set such a standard for assessment or determine such an attribute among faculty. University centers for teaching, learning, and assessment may benefit from intellectual curiosity clarification to help improve their support of effective teaching strategies and the development of academic assessments.

In the workforce realm, employers are looking for intellectually curious employees who demonstrate the ability to solve problems and are adaptable to learning new technologies or solutions that will advance the evolving workplace (Mussel et al., 2012). In addition, survival in the workplace is dependent on the innovation and creativity of an employee (Anderson, Potočnik, & Zhou, 2014). Attributes such as innovation and creativity may indicate intellectual curiosity. Perhaps in the future, citizens may also look for attributes of intellectual curiosity in their politicians.

As indicated by previous research efforts (Kashdan, Rose, & Fincham, 2004; Mussel, 2013; von Stumm et al., 2011), an empirical definition determined for the term intellectual curiosity is the first step in assisting a cross cultural, multidisciplinary approach for researching intellectual curiosity and advancing the field beyond correlational or path model studies of different measurements. The study addressed these efforts by determining a theoretical and empirical definition for the term intellectual curiosity.

**Research Question**

A single research question guided this study: Will an empirical examination of the interrelationships among the constructs posited by Cattell and Berlyne such as curiosity,
thinking, and intellectual engagement provide an empirically valid definition of intellectual curiosity?

**Definition of Terms**

**Collative variables.** Group of stimulus variables that provoke a comparison of information, thereby inducing insecurity, such as novelty, uncertainty, conflict, and complexity (Berlyne, 1954).

**Crystallized intelligence.** Discriminatory habits long established in a particular area, originally through process of fluid ability, but no longer necessitates perception for successful operation (Cattell, 1943).

**Curiosity.** Described by Berlyne (1978) as “an internal state occasioned when subjective uncertainty generates a tendency to engage in exploratory behavior aimed at resolving or partially mitigating the uncertainty” (p. 98).

**Diversive curiosity.** Curiosity caused by boredom and a need for stimulation; a person will seek out new experiences as a relief from boredom (Berlyne, 1960).

**Drive.** A strong stimulus that forces action. The stronger the stimulus, the more drive function it possesses (Miller & Dollard, 1941).

**Epistemic curiosity.** A state of arousal caused by intellectual uncertainty and motivates information seeking behavior (Berlyne, 1960).

**Erg.** An innate reaction toward a specific goal, through a learned process (Cattell, 1987).

**Ergic tension.** Similar to Berlyne’s description of arousal, but described by Cattell as a measurable level of drive strength of an instinctual pattern (Cattell, 1987).
**Exploration.** Kashdan et al. (2009) describe exploration as “an orientation toward seeking novel and challenging objects, events, and ideas with the aim of integrating these experiences and information” (p. 988).

**Exploratory behavior.** Any form of mental, physical, or psychomotor activity that reduces the internal state of arousal in an individual (Reio, Petrosko, Wiswell, & Thongsukmag, 2006).

**Fluid intelligence.** Cattell (1943) described fluid intelligence as “a general ability to discriminate and perceive relations between fundaments, new or old” (p. 178).

**Intelligence.** The ability to adapt to new situations (Piaget, 1947/1967).

**Intrinsic motivation.** Berlyne (1971) defined intrinsic motivation as a “mechanism of motivation inherent within information processing and action” (p. 7).

**Investment theory.** Cattell (1987) explained investment theory as “the theory that both the general unifactor form and individuals’ levels on \(g_c\) arise from variations in the degree of investment of fluid intelligence, \(g_f\), by different people in the total area of learning activities” (pp. 629-630).

**Need for cognition.** Cohen, Stotland, and Wolfe (1955) coined the term need for cognition as “a need to structure relevant situations in meaningful, integrated ways…a need to understand and make reasonable the experiential world” (p. 291).

**Perceptual curiosity.** Curiosity leading to increased perception of stimuli and equally effecting any of the five senses (Berlyne, 1949).

**Personality.** Cattell’s (1950) definition of personality includes “that which permits a prediction of what a person will do in a given situation” (p. 2).
**Source trait.** A trait defined as a simple structure factor (statistically) and “a pattern of behavior due to a single source” (Cattell, 1987, p. 632).

**Specific curiosity.** Seeking specific information from a definite source (Berlyne, 1960, 1962).

**State curiosity.** How an individual feels at a particular moment (Spielberger & Starr, 1994). Curiosity in a particular situation (Lowenstein, 1994).

**Surface trait.** The pattern of a correlation cluster, perhaps the composite result of several factors (Cattell, 1987).

**Trait.** Underlying influence accounting for patterns of observable behavior (Cattell, 1987).

**Trait curiosity.** How an individual feels in general (Spielberger & Starr, 1994). General capacity or propensity to experience curiosity (Lowenstein, 1994).

**Chapter Summary**

Curiosity and intelligence theories have evolved throughout history to explain behavior and identify positive individual attributes. Intellectual curiosity has become the innovative prerequisite for admission to colleges, universities, specialized programs, as well as entrance into the workforce. Researchers, educators, and employers have some notion of characteristics that represent the term, intellectual curiosity, but lack consistency in their respective definitions and measurements for the term. The purpose of this study was to examine the interrelationships among the constructs posited by Cattell (1943, 1957, 1987) and Berlyne (1954, 1960, 1962) in the expectation of developing and determining a theoretical and empirical definition of intellectual curiosity. This study will extend the continuum of research and academic practice by defining the elusive, but often used term, intellectual curiosity.
CHAPTER II
LITERATURE REVIEW

The current study is designed to explore a model of intellectual curiosity and develop an empirical definition of the concept using the theoretical framework from Cattell’s (1943, 1957) Intelligence Theory and Berlyne’s (1954, 1960) Theory of Curiosity. The rationale for this study necessitates a definition of intellectual curiosity to assist practitioners and researchers in incorporating the concept into specific application fields, such as education and psychology, and for purposes of assessing the effectiveness of intellectual curiosity. Results from this study may inform future researchers in the development of valid measures of intellectual curiosity as well as assisting college and university administrators with providing a new criterion for admission decisions in an ever-increasing competitive world.

The International Society for the Scholarship of Teaching and Learning (ISSOTL) hosted an international workshop in 2014 for academic development to help stimulate the intellectual curiosity of higher education faculty with the aim of influencing teaching practices to enrich students’ learning (Matthews & Healey, 2014). A concrete definition of curiosity would benefit such academic professional development. The president of Wake Forest University recently remarked:

[intellectual curiosity] is crucial for the vitality of your [student’s] sense of long-term calling. Whether you will be spending time teaching, or in research, in public service, or in management, keeping alive a flame of curiosity will give motivation and meaning to what you do” and to the ideal that learning for learning’s sake is still important to our society. (Gilroy, 2013, para. 6)
Educators may benefit from having a firm understanding of what comprises intellectual curiosity for incorporating the construct into the curriculum and for determining a method of measuring an intellectual curiosity outcome for a course. In addition, higher education administrators and specialized program directors may benefit from a definition for developing admission decisions based on objective measures, in addition to or in place of test performance scores and letters of recommendation. In specialized programs such as nursing, athletic training, medical technology, education, and engineering, a strong indication of a student’s commitment and success may be determined by a measure of intellectual curiosity. With these application considerations of the construct of intellectual curiosity for educators and administrators, examining curiosity and intellectual investment collectively may move researchers closer to determining a definition of intellectual curiosity and its value to higher education.

Chapter II encompasses the history of curiosity from philosophical, psychological, and educational perspectives as well as the history of intelligence. Secondly, the chapter reviews the constructs related to intellectual curiosity through the combining of two theories: Cattell’s theory of intelligence and Berlyne’s theory of curiosity. The theoretical framework for the study is illustrated in Chapter II as a nomological network derived from the relevant literature. The chapter also consists of a review of current literature and previous research related to curiosity and the development of the concept of intellectual curiosity. The chapter culminates with a Chapter summary.

Historical Overview of Curiosity

Curiosity has been used to refer to traits, internal states, and motivations for behavior such as officiousness and sensation seeking (Byman, 2005; Spielberger & Starr, 1994). Curiosity is cited in literature and art (Kreitler & Kreitler, 1972), psychological development (Piaget,
1936), pedagogy (Pluck & Johnson, 2011), and scientific discovery (Day, 1982). Moreover, curiosity has been viewed as a need, a desire, or a thirst for knowledge (Edelman, 1997). The following discussion sections will provide a brief history of curiosity from philosophical, psychological, and educational perspectives.

**Philosophical.** Aristotle begins *Metaphysics* (350 B.C./1941) with a discussion on the innateness of human curiosity that he describes as a “desire to know” (p. 689). According to Aristotle, knowledge in the form of science and art comes from experience and those with experience succeed more than those without experience. The pursuit of knowledge, from Aristotle’s perspective, focuses on the notion of an individual seeking an intrinsically motivated desire for information. Aristotle (350 B.C./1941), also supported curiosity perhaps perceived as knowledge sought for the sake of knowing (p. 692). Cicero (50 B.C./1914) also referred to curiosity as the “innate love of learning and knowledge…without the lure of any profit” (p. 486). Although often interpreted as paradoxical, Saint Augustine (401/2009) described curiosity as a passion for knowledge, but also a dangerous temptation “when people study the operations of nature which lie beyond our grasp, when there is no advantage” beyond a desire for knowledge “for its own sake” (p. 211).

In the eighteenth century, the philosopher Hume (1777/1888) supported two types of curiosity: scientific inquisitiveness and officiousness. Hume focused on the notion of human nature to have occasions of uneasiness or pain when met with the novelty of an event or information, or as a desire to know the unknown. The pain or uneasiness that initiates a search for information provides an innate need to seek reasons for alleviating the unknown or uneasiness or pain. Although these philosophical perspectives describe the innateness of
curiosity and suggest behavioral systems at work, a psychological perspective informs the behavioral drive of curiosity.

**Psychological.** William James (1890/1950) described two types of curiosity: 1) an instinctive basis of human curiosity formed by the “susceptibility for being excited and irritated by the mere novelty…of the environment” (p. 429); and 2) scientific curiosity focused on a specific item of information as the brain’s response to a gap in an individual’s knowledge. James (1890/1950) suggests fear and curiosity form an antagonistic relationship, produced by the same stimuli and useful to the individual. Curiosity is considered by James (1890/1950) to be a primary instinct in which novel objects or events evoke both exploratory and avoidance behaviors, whereas fear seeks to reduce the risk or dangers posed by exploration.

Piaget (1936) emphasized curiosity with regard to children’s cognitive development. Although Piaget did not specifically address the subject of drive, he described curiosity and exploration through adaptation using the principles of assimilation and accommodation. Piaget (1936) defined intelligence as behavioral adaptations to novel situations; adaptation was described as “an equilibrium between the action of the organism on the environment and vice versa” (p. 7). Assimilation is a motivational process in which a child uses an existing cognitive structure to interpret an experience (Piaget, 1936). When a child experiences new information or situations, the cognitive structure is modified or accommodated to correspond to the new experience (Piaget, 1947/1967). A child’s curiosity lies in the exploratory behavior, “The more a child sees and hears, the more he wants to hear and see later” (Piaget, 1936, p. 276). Moreover, the novelty of the experience will pique the child’s curiosity to seek out new stimulation.
Educational. As a philosopher, psychologist, and outspoken educational reformer, John Dewey (1897, 1910) often referred to curiosity in his publications, but did not study the topic empirically. Dewey described the curious mind as

constantly alert and exploring, seeking material for thought, as a vigorous and healthy body is on the *qui vive* for nutriment…Such curiosity is the only sure guarantee of the acquisition of the primary facts upon which inference must base itself. (p. 31)

While the instinctual physical childhood behaviors, such as touching, reaching, or experimenting are not intellectual in nature, these behaviors are operational foundations for intellectual activity. In addition, these physiological behaviors lead to the social stage of curiosity pronounced by the child’s endless “why?” questions (Dewey, 1910). Although a child’s constant “why” questions may not provide evidence of rational thought, these types of questions demonstrate the child’s search for greater information. Dewey (1910) refers to the “germ of intellectual curiosity” (p. 32) as evolving from the barrage of questions and the child’s connection with the world. Curiosity is elevated above the physiological and social experiences to become an intellectual force when it is “transformed into interest in problems provoked by the observation of things and the accumulation of material” (Dewey, 1910, p. 32). Dewey (1910) further explains that some people experience an intellectual curiosity “so insatiable that nothing will discourage it, in most its edge is easily dulled and blunted…others retain curiosity only with reference to what concerns their personal advantage in their chosen career” (p. 33). Dewey’s (1897, 1910) vehement belief posited the following educational viewpoint: the primary function of education is to stimulate thinking and interest. Dewey also posited neither thinking nor interest should be “humored nor repressed” (p. 80).
Historical Overview of Intelligence

Although the idea of intelligence dates back as early as Plato (2007), who spoke of thought and reason in relation to the soul, the modern foundation for human intelligence was not established until the late 19th century (Plucker & Esping, 2014). The following section will provide a brief history of the modern theory of intelligence.

Galton. In 1883, Galton explored the human ability and the development of the human being, establishing the foundation for psychometrics and behavioral heredities. The idea of a general mental ability, the heritability of individual differences in ability, and the anticipated measurement of general ability propelled Galton into the groundbreaking science of intelligence theory. Galton’s main interest was in the underlying causes of individual differences in human mental abilities with the hereditary component exhibited in different types of intellectual achievement (Galton, 1883/2001). Although Galton (1883/2001) did not propose a psychometric understanding of general ability, Galton’s discovery of the application of the normal distribution applied to general abilities is historically noteworthy. According to Jensen (2002), the instruments and techniques of the late 1800s did not offer the precision and reliability necessary for adequately assessing Galton’s hypothesis. Fisher later developed appropriate statistical inferential analysis methods in 1925. Although sometimes perceived as eccentric, Galton’s rudimentary use of the measures of central tendency, interquartiles, and normal frequency distribution for scaling intelligence has since been shown to correspond to modern IQ tests, affirming Galton’s work was “before his time” (Fisher, 1956/1973, p. 2).

Spearman. Inspired by Galton’s work, Spearman (1904a, 1904b) sought to refine the theory of intelligence psychometrically. Spearman’s theory of intelligence differed from Galton’s perspective of intelligence because Spearman derived the theory of intelligence from
correlating various test scores, representing a common source of variance, rather than using the summation of test scores with the theory of intelligence based on frequency distributions (Spearman 1904a, 1904b). Spearman’s identification of a common source of individual differences became one of the most important contributions to modern psychometric theories focused on the theory of intelligence. The process known as factor analysis, developed by Spearman (1904a), is a method of identifying factors or influences that explain a particular pattern of observations. Spearman’s efforts to develop “g,” or general ability, using factor analysis offered substantial contributions to the fields of education and psychology, while presenting a myriad of challenges to educators and psychologists. Spearman (1904a) stipulated the determination of g should be obtained from positive correlations of several measures of abilities to accurately indicate a common unitary factor or common source among tests of cognitive abilities. This common unitary factor or source, namely g, is responsible for individual differences in performance on tests, indicating intelligent behavior originates from a common source. Although modern theories of multiple intelligences have rejected Spearman’s (1904a) discovery of a general factor, g, of intelligence, empirical research has confirmed the following hypothesis: Cognitive performance is positively correlated across the population regardless of cultural differences and factor analysis remains one of the most powerful tools in modern research. After years of reworking the theory of a unitary g construct, Spearman (1927) rearranged the order of the tests within the correlation matrix and realized there was a ‘hierarchy’; the correlation coefficients decreased in size diagonally from left to right. This, hierarchy, Spearman (1927) believed, was evidence of humans’ abilities having two contributions: (a) general ability and (b) ability specific to performance. Spearman’s established correlation results among all types of abilities tended to be positive, thus supporting the theory of
a broad, general ability factor or $g$ factor and a less common specific ability factor. Test performances loading highly on $g$ involved the ability to think abstractly, according to Cattell (1987), and suggested a definition of intelligence as “capacity to acquire capacity” (p. 25). According to Cattell (1987), Spearman explained the modified model using an engineering analogy: “$g$ was the size of the main power house, while the s’s [second hierarchy of specific abilities] represented the magnitude of special engines and particular localities which employed the power” (p. 27).

**Binet.** Alfred Binet, despite receiving a degree in law, was drawn to the field of psychology, particularly the study of intelligence. In an effort to self-educate, Binet read extensively in psychology and eventually developed a theory of intelligence based on the observational development of his two daughters (Binet, 1890). In 1905, in concert with Theodore Simon, Binet began developing an intelligence scale, initially designed to identify children of limited mental abilities, and later evolved into the Binet-Simon Scale (Binet & Simon, 1905/1916). The Binet-Simon Scale measured abilities including reasoning, vocabulary, problem solving, and mathematics, established the “normal” cognitive functions of children, and was used for educational placement. When a child completed the Binet-Simon Scale, the overall score was then compared to specified norms and the child was assigned a “mental age.” Binet (Binet & Simon, 1905/1916), believing intellectual development was influenced more by environment than genetics and was not generalizable, stressed the use of qualitative rather than quantitative measures to study intelligence. Binet used the summation of scores on the ability tests as a method of measuring intelligence rather than multiple scores as measures of multiple abilities. Binet’s use of a summation score aroused criticism from the field of psychology, particularly from Charles Spearman (1904a, 1904b).
Section summary. This section offered a brief synopsis of the philosophical, psychological, and educational perspectives related to curiosity as well as the historical perspectives of intelligence. These perspectives provide the background and venues for modern theories of curiosity and intelligence.

Theoretical Framework Development

The purpose of the current study is to explore a model of intellectual curiosity, develop a definition of intellectual curiosity, and propose a method for measuring intellectual curiosity by bridging two theories of curiosity and intelligence. The current study provides a theoretical framework founded on the constructs of Cattell’s (1943, 1957, 1987) theory of intellect and Berlyne’s (1954, 1960) theory of curiosity. A graphical representation of the nomological network for the framework encapsulating the constructs and associated variables from Cattell’s theory of intellect and Berlyne’s theory of curiosity is depicted in Figure 2. The section following Figure 2 includes a discussion of the constructs related to each theory based on Cattell and Berlyne as well as a parallel discussion of the relationships between the two theories.
Figure 2. Theoretical framework integrating theories of Cattell and Berlyne. Adapted from Berlyne (1954, 1960, 1962); Cattell (1943, 1957, 1963, 1987). Measures: BFI (John, Donahue, & Kentle, 1991); CEI-II (Kashdan et al., 2009); NCS (Cacioppo, Petty, & Kao, 1984).

Theory of Intelligence

Although previous theoretical perspectives of intellect existed prior to the World War II period (Binet, 1916; Galton, 1883, 1907/2001; Piaget, 1936; Spearman, 1904a, 1904b), modern day theoretical perspectives of intellect are attributed to Cattell (1943). Cattell focused on the unitary construct of Spearman’s (1904a, 1904b, 1927) g theory of intelligence and began developing the g theory of intelligence into the multidimensional theory of intelligence and personality testing used today. Cattell (1987) noted two reasons for the importance of intelligence in the fields of psychology and education: (a) allows for the application of the scientific method to psychological problems, and (b) “is of immense practical importance, educationally, socially, and in regard to physiology and genetics” (p. 1).
In 1940, Cattell created the *culture fair test*, containing only material common to all cultures, in an effort to minimize the effects of cultural differences in eliciting complex relations (perceptual test). The culture fair test generated a very different degree of IQ dispersion than performance intelligence tests and led Cattell (1987) to the belief in fluid performance ability ($g_f$). In addition, research of participants with brain injury indicated subjects may perform differently on traditional IQ tests. An injury to the frontal portion of the left hemisphere, Broca area, may produce loss in verbal ability, but not affect spatial or numerical ability to the same extent. However, sensory damage to almost anywhere “seems to produce some loss in fluid ability” (Cattell, 1987, p. 94). These findings cemented Cattell’s (1943) theory of two ability factors: *fluid* and *crystallized intelligence*. Intensive investigation of the theory over the course of approximately 20 years, with thousands of participants varying in ages from 5-61 years of age, across diverse races, cultures, and educational background, using various batteries of intelligence tests as well as the culture fair test, Cattell (1987) employed three essential conditions of meaningful factor analysis:

1. A check by two or three independent methods (the scree, the Kaiser-Guttman, or Lawley criteria) on the actual number of factors to take;
2. A simple structure rotation to demonstrably unique resolution;
3. Certain broader, experimental design principles beyond statistics, e.g., ensuring a wide choice of behaviors, of types of people, etc., in relation to theory. (p. 109)

With extensive, yet important methods, Cattell generated the theory of intelligence comprised of two factors. Although Cattell, who was Spearman’s graduate assistant, was reluctant to question Spearman’s unitary factor theory of $g$, Cattell wanted to maintain continuity with Spearman’s (1904a, 1904b) original $g$ theory, so he dubbed his factors $g_f$ and $g_c$. Cattell (1963) suggested
intelligence is not demonstrated solely by cognitive performance, but through factor analysis, abilities generally associated with general intelligence load within two categories: fluid and crystallized intelligence.

**Fluid intelligence.** Abilities unrelated to cultural skills fall into the fluid intelligence category \( (g_f) \). The general ability to discriminate between new or old experiences and adapt to new situations increases until approximately age 21 then begins to decline steadily throughout the remainder of life (Cattell, 1943, 1987). Fluid abilities are not associated with any specific habits or specific sensory, motor, or memory areas, but are biological factors such as general reasoning, figural/non-verbal expression, and problem solving abilities. Because these abilities are not related to any type of cultural skills, fluid intelligence will rise at its own rate, beginning at birth, and will later decline despite cultural influences or injury (Cattell 1987). Cattell’s (1943) research indicated fluid intelligence decline was correlated with occupational field and level of education. Individuals with higher educational backgrounds tended to experience fluid decline approximately 4 to 6 years later than individuals who did not attend college.

**Crystallized intelligence.** Cattell (1943) contended the concept of intelligence or \( g \) encompasses an interaction between an individual and his or her environment. The development of more purposeful ability is dependent on an individual’s fluid intelligence (Horn & Cattell, 1967). The ability to recognize and adapt new information or situations enables an individual to collect the new information from the environment or culture and apply the knowledge gained—this process is indicative of crystallized intelligence \( (g_c) \). In support of Cattell’s (1987) theory of crystallized intelligence as “a product over time of earlier fluid ability action” (p. 94), Hebb (1942) noted recovery will usually occur in crystallized abilities if damage to the brain occurs after maturity, but damage occurring in the same areas prior to maturity result in long term
impairment. The crystallized abilities are demonstrated by the application of verbal or conceptual knowledge acquired through experiential learning and increase across the lifespan in relation to fluid abilities (Cattell, 1943, 1957, 1987). Whereas fluid abilities begin to steadily decline after the approximate age of 21, crystallized abilities continue to gain well into age 40-50; therefore, adult performance on intelligence tests are more indicative of crystallized abilities (Cattell, 1943). Later Cattell (1987) distinguished his theory as an investment theory, “because crystallized ability becomes the trustee of gains from investment by fluid ability” (p. 120).

**Investment theory.** Cattell’s (1943) investment theory suggested age-related changes in cognitive performance are influenced by certain characteristics or personality traits determining the way mental abilities are applied. As previously discussed, fluid abilities begin at birth as biological factors, determining how an individual will respond to experiences and learn from the experiences. Crystallized abilities are built on the foundation of fluid knowledge and subsequent interactions with the environment. The development of fluid and crystallized abilities progresses at a steady rate with crystallized solidly formed. An analogy may be the fluid form of water freezing; as more water flows over, it repeatedly freezes. As the repetitive cycle continues, the ice grows. An individual’s fluid ability is “invested” in learning to produce greater crystallized ability. Learning occurs in response to social environment and direct school curriculum. The level of obtained school achievement is a function of both $g_f$ and other factors such as time, interest, and memory. Cattell (1987) hypothesizes a causal action between $g_f$ and $g_c$, but recognizes other underlying influences, termed traits, may account for certain patterns of behavior or performance. Cattell distinguished traits as two types: surface traits and source traits. Through factor analysis, Cattell (1987) found the clustering of variables in a correlation matrix suggested surface traits because the clusters indicated the variables “go together” (p. 15),
but provided no evidence of derivation from a single source. Such surface traits may include general ability, personality, or other “nonpsychological data” (Cattell, 1987, p. 16). Ability measures often examine variables such as knowledge of vocabulary, history, literature, and mathematical problem solving. In correlational analysis, these variables cluster together forming a surface trait, referred to as performance or intelligence (Cattell, 1987). Cattell’s research and analyses indicated other factors may contribute to intelligence—possibly a combination of educational experience and natural intellectual ability. According to Cattell (1987) all four variables, vocabulary, history, literature, and mathematical problem solving, were influenced by natural ability and education. Source traits, on the other hand, were found to demonstrate simple structures when rotated in factor analysis (Cattell, 1987).

More specifically related to an intellectual theory was Cattell’s (1987) contention of certain traits perhaps predisposing an individual to seek out particular environments, successively stimulating cognitive practices. Therefore, these particular influencing traits may enhance intellectual development. Traits are explored more in the following section.

**Relationship between intelligence and personality.** In 1945, Cattell once again used factor analysis to shift his focus to defining the basic constructs of personality, which he termed traits. An individual’s personality offers a glimpse of what an individual will do in a particular situation. Through the exploration of traits, researchers are able to understand the structure and function of personality and predict behavior (Cattell, 1950, 1957, 1987). Cattell used three different data sources: Life records (L data), questionnaires (Q data), and objective tests (T data) to identify personality traits. Cattell’s work comprised very large data sets, resulting from no particular battery of tests. L data consisted of extant data in the form of school grades and attendance records, as well as work attendance records in adults. Q data consisted of self-report
questionnaires designed to rate an individual’s personality, interests, and attitudes. Data were obtained from observations of test subjects’ reactions to experimental situations (Cattell, 1957 1987). Cattell believed a more comprehensive assessment of personality would result by capturing data from three different sources. After using factor analysis, Cattell (1957) determined the existence of 16 source traits or primary factors of personality (16PF). After initially using uniquely Cattellian terminology, such as Parmia, Prem sia, and Coasthenia, to name each of the factors, Cattell received much criticism from the psychological community. Cattell (Cattell, Cattell, Cattell, Russell, & Bedwell, 2003) revised to the following factor names and associated letters of identification: Warmth (A), Reasoning Ability (B), Emotional Stability (C), Dominance (E), Liveliness (F), Rule Consciousness (G), Social Boldness (H), Sensitivity (I), Vigilance (L), Abstractedness (M), Privateness (N), Apprehension (O), Openness to Change (Q1), Self-Reliance (Q2), Perfectionism (Q3), and Tension (Q4). Of these 16 source traits, there were three trait dimensions: Temperament Traits, Ability Traits, and Dynamic Traits (Cattell, 1957). Temperament traits were related to an individual’s behavior, such as anxiety, indecision, irrational fear, and neuroticism (to name a few). Ability traits were related to problem solving (reasoning) ability and the speed an individual can perform a task (fluid intelligence). Dynamic traits were related to motivations originating from the drives or needs an individual seeks to satisfy (Cattell, 1965). Dynamic traits were further broken down into sentiments, attitudes, and ergs (Cattell, 1987). Sentiments and attitudes were interrelated traits developed through environmental or cultural influences (Cattell, 1947). Cattell (1947) explained the interrelationship as “attitude, sentiment, and erg correspond to twig, bough, and trunk in describing the ‘subsidization’ of a tree” (p. 227). In an attempt to clarify his new terminology, Cattell (1947) stated “they [sentiments, attitudes and ergs] are all of degree; a line cannot be
sharply drawn” (p. 227). Again, using unique terminology, Cattell (1947, 1987) referred to drive as erg. Cattell’s (1987) erg described an innate reaction toward a specific goal through learned processes in an effort to satisfy a need or desire. Erg was used rather than drive because Cattell believed the term drive lacked operational precision and erg was more demonstrable through experimentation. One of the 11 types of ergs discussed by Cattell was curiosity. The terms curiosity and exploration were used synonymously by Cattell.

Cattell (1987) described a “complex interaction between intelligence and personality,” (Boyle et al., 1995, p. 5) and both are interpreted as enduring traits. Cattell (1987) found that when individuals are exposed to academic learning situations, intelligence is highly correlated with the personality trait of abstractedness. In addition, higher intellect tended to be positively associated with personality factors such as dominance, openness to change, and self-reliance. Cattell (1987) suggested the findings indicated higher scores in the personality factors dominance, openness to change, and self-reliance, were “results of the constantly greater experience of success that goes with higher intelligence” (p. 453). Certain personality traits positively influenced the development of cognitive abilities by providing more opportunities for learning (Cattell, 1987). While Cattell (1987) acknowledged performance based tests such as the SAT, ACT, and MAT are useful for predicting future college performance, Cattell argued the tests alone were not sufficient. The inclusion of personality and motivation tests provides a more complete picture of a student’s “life achievement” (Cattell, 1987, p. 464). Personality factors may contribute to intelligence test performance as well as the overall development of intellectual skills (Boyle et al., 1995; Cattell, 1987). An example of the interrelationship of drive, curiosity, and intelligence is a high school student’s exposure to a unit on marine biology and the student’s subsequent interest in observing marine life. The student’s curiosity is stimulated by a lack of
knowledge about marine biodiversity and a great deal of time is invested engaging in activities
related to marine experiences (scuba diving, seining, and visiting aquariums). The student’s
newfound love of marine science (positive sentiment) is grounded in the interest in science
satisfying the curiosity about marine biodiversity. The information gained in the process may
fuel the student to seek higher education programs focused on marine biodiversity.

Cattell (1987) further suggested a symbiotic relationship between ability and personality
evidenced in development and immediate performance. Developmentally, ability affects
personality as personality also affects ability growth; in immediate performance, ability modifies
personality expression as personality affects ability performance (Cattell, 1987). In one of
Cattell’s final articles, he noted, “Cattellian psychology provides one of the few models which
actively seeks to integrate the roles of personality and intelligence within the same psychometric
instruments” (Boyle, Stankov, & Cattell, 1995, p. 25).

Unfortunately, Cattell’s 16 factors did not survive the test of explicit replication. Cattell
(Cattell & Krug, 1986) argued other researchers’ lack of replication was due to their inability to
follow the methodology and factor analytic work, but later Cattell was also unable to replicate
the exact findings. Through further research and the technological advancement of statistical
software, Cattell’s original theory of 16 personality factors has been reduced to a five factor
theory (McCrae & Costa, 1987, 1992; Tupes & Christal, 1961), known as the Big Five (Costa &
McCrae, 1990; DeYoung, Quilty, & Peterson, 2007; Goldberg, 1990). Cattell’s empirical
discoveries certainly developed a foundation for the investigation and later identification of the
Big Five factors of personality: (a) Openness or Intellect, (b) Consciousness, (c) Extroversion,
(d) Agreeableness, and (e) Emotional Stability (Costa & McCrae, 1992a; DeYoung et al., 2007;
Goldberg, 1990; McCrae & Costa, 1987; Tuples & Christal, 1961). The Big Five factors model of personality will be further explored later in this chapter.

Theory of Curiosity

James and Dewey are two of the historically great thinkers who briefly referred to curiosity. As much as the concept of curiosity is discussed throughout history, not until Berlyne (1949, 1954) was empirical evidence applied to the development of a formal theory of curiosity.

The term curiosity is used across most academic disciplines and has been addressed in the literature in certain waves” of publications (Lowenstein, 1994, p. 75). Berlyne’s description of a curiosity drive included exploration or exploratory behavior to seek new information. Figure 3 depicts the reinforcing function of curiosity as explained by both Cattell and Berlyne. Curiosity is stimulated by a feeling of arousal, or ergic tension (Cattell, 1957) caused by the individual’s realization of a conflictive gap in knowledge. Curiosity is evidenced by the individual’s engagement in exploratory or information seeking behavior. Once information is gained, the conflict is reduced. The entire process of stimulation, search for information, and reduction of conflict is reinforcing and therefore, an individual is more likely to engage in the process when met with similar circumstances, such as an information gap or uncertainty of information. Figure 3 depicts the reinforcing cycle of curiosity.
Berlyne (1960) developed James’ idea of curiosity into more specific terms to describe curiosity as a drive. However, James’ theory of an instinctive drive of curiosity is described by Berlyne (1954) as perceptual curiosity and is aroused by novel stimuli and reduced by continued exposure to said stimuli. James’s theory of scientific curiosity is described by Berlyne (1954, 1960) as specific curiosity in which specific information is sought based on a gap in one’s knowledge in an attempt to reduce conflict.

**Elements of curiosity.** Berlyne (1954) differentiated four types of curiosity: perceptual, epistemic, diversive and specific. Perceptual and epistemic are related in terms of the types of stimuli triggering the responses and associated behaviors, whereas diversive and specific are terms used to explain curiosity in terms of behavior.

**Perceptual and diversive curiosity.** According to Berlyne (1960), perceptual curiosity is defined as “states of high arousal that can be relieved by specific exploration” (p. 195). Although perceptual curiosity is cued in response to a stimulus or increase in arousal, such as particular
sights or sounds, diversive curiosity is triggered by boredom and a need for stimulation (Berlyne, 1960, p. 80). This process results in diversive exploration, such as searching the internet or immediate surroundings for something interesting.

**Specific and epistemic curiosity.** Epistemic curiosity is most often associated with specific knowledge or information seeking with an intended purpose. The seeking of specific information based on a gap in one’s knowledge in an attempt to reduce conflict is described by Berlyne (1960) as specific exploration (p. 80). Berlyne (1963) describes the process of curiosity and exploration as having a reinforcing function because of the initial conflict, “the psychological function of information is to reduce conflict” (p. 324). Berlyne (1962) described epistemic curiosity as “a motivational state (a state of high drive or arousal) that actuates quests for knowledge and is relieved by acquisition of knowledge” (p. 27).

According to Berlyne (1960), the mechanisms or variables of epistemic seeking behavior are a) epistemic observation; b) consultation; and c) epistemic thinking. Each of the variables of epistemic behavior, observation, consultation, and thinking play a role in intellectual development.

**Observation.** Epistemic observation involves exploration and knowledge seeking behavior. The exploratory behavior places an individual within environments cultivating the learning process. The environments may include scientifically experimental observing or everyday observations perhaps captivating an individual’s attention as in the example of perceptual curiosity. The most important component of epistemic observation is whether the behavior leaves “a lasting residue of knowledge” (Berlyne, 1960, p. 265) and whether the residue becomes reinforcing to the individual.
Consultation. Berlyne’s (1960) notion of consultation refers to an individual’s knowledge gain from exposure to other individuals. This behavior may be evidenced by a student asking questions, seeking information from books, or online searches.

Thinking. Observation and consultation can only occur in conjunction with thinking, since thinking will usually precede, accompany, and follow any type of knowledge seeking behavior (Berlyne, 1960). Epistemic thinking is similar to creative thinking and requires an individual to apply newly acquired knowledge through the manipulation of symbolic sequences (Berlyne, 1960). The role of epistemic behavior is to supply the individual with knowledge, since curiosity is the desire for knowledge. If the knowledge sought is then stored and the process of obtaining the knowledge was satisfying, this rewarding process is likely to be repeated, thus resulting in intentional learning. In 1966, Berlyne found intelligence and curiosity were contributing characteristics to retention of information. Furthermore, knowledge seeking behavior is reinforced by the ability to easily recall answers to test questions.

Theory Integration

The curiosity drive evidenced by Berlyne’s (1954, 1960) theory of thinking, observing, and consulting behaviors relates to Cattell’s (1943, 1957) theory of intellectual investment being comprised of intelligence and personality characteristics. Both Berlyne and Cattell described the reinforcing function of curiosity, which is stimulated by tension (Cattell, 1957) or arousal (Berlyne 1954, 1960) and caused by an individual’s recognition of a gap in known information. An individual will then engage in exploratory or information seeking behavior, which may consist of interacting with other individuals or consulting written or electronic sources. The integration of constructs from each of the theories is necessary to develop a framework for measuring intellectual curiosity. Figure 1 illustrates the constructs and variables within the
nomological network of Cattell’s theory of intelligence and Berlyne’s theory of curiosity. Berlyne’s theory of curiosity described an individual’s psychophysiological state at a given point in time, but failed to consider the impact of personality characteristics. With the inclusion of Cattell’s investment theory, the two theories come together to support the measurement of thinking, exploration and knowledge seeking, consultation, and intellectual engagement; variables hypothesized to contribute to the identification of intellectual curiosity.

**Related Literature**

**Intelligence and personality.** Goff and Ackerman (1992) explored the relationship between intelligence and personality using the investment theory model. The 1992 study particularly explored how the extent to which individuals intellectually engaged their environment may predict typical intellectual performance. Records of GPA, ACT/SAT scores, personality questionnaires, and self-report measures of interest in engaging in intellectual activities were employed to gather data from 138 participants (Goff & Ackerman, 1992). Following a series of analyses, Goff and Ackerman determined that typical intelligence, or the way an individual is most likely to perform, can be predicted by measuring variables of personality, specifically these five factors: Openness, extroversion, agreeableness, and neuroticism. In addition, Goff and Ackerman (1992) coined the term Typical Intellectual Engagement (TIE) as a new construct to describe “A personality trait hypothesized to relate to typical vs. maximal intellectual performance” (p. 539). In a later study, von Stumm and Ackerman (2013) used meta-analytic methods to identify eight trait categories related to intellectual investment and the strength of association between investment traits and indicators of adult intellect, such as GPA, college entrance exams, and intelligence batteries. The researchers first identified the eight trait categories by 60% interrater agreement upon reviewing the
investment trait constructs of published research from 1938 to 2006 relative to individual differences in personality and intelligence. A “core of investment” (von Stumm & Ackerman, 2013, p. 7) was found to be the first category of investment traits, indicated by the Typical Intellectual Engagement (TIE) and Need for Cognition (NFS) scales. This core is “the tendency to seek out, engage in, enjoy, and continuously pursue opportunities for effortful cognitive activity” and “understand the environment” (von Stumm & Ackerman, 2013, p. 7). A second, related category was Intellectual Curiosity, which also represented individual differences in the desire for “knowledge and engagement in cognitively stimulating activities” (von Stumm & Ackerman, 2013, p. 8), but was less representative of an individual’s need to understand the environment. Subsequent categories were Abstract Thinking, Novelty Seeking, Openness, Absorption, Ambiguity, and Social Curiosity. Although each category was briefly described, Intellectual Curiosity, Abstract Thinking, Novelty Seeking, Openness, Absorption, Ambiguity, and Social Curiosity were not the focus of the meta-analysis. Rather, the four most studied investment traits were analyzed: Intolerance for Ambiguity, Intellectual Efficiency, Need for Cognition, and Typical Intellectual Engagement. Meta-analytic associations between each trait and performance measures (crystallized intelligence) were determined and concluded positive associations between investment personality traits and indicators of adult intelligence and these associations “differ in strength, but not direction” (von Stumm & Ackerman, 2013, p. 15).

A 2007 study (Woo, Harms, & Kuncel) used a relatively small sample (n = 81) to investigate the “construct validity and distinctiveness” (p. 1636) of the Need for Cognition (NCS) and Typical Intellectual Engagement (TIE) scales. The two scales were found to be highly correlated and lacking divergent validity. In addition, the scales were highly correlated with the Openness scale of the Big Five Inventory (BFI). Finally, Woo et al. (2007) argued the two scales
were measuring the “same personality characteristics specifically related to intelligence” (p. 1635). Woo et al. (2007) also found that although TIE and NCS were correlated with Openness and Conscientiousness, neither of the two scales were correlated with Extraversion, Neuroticism, nor Agreeableness.

Sophie von Stumm (2012) investigated the relationship of need for cognition, cognitive engagement activities, age, and cognitive performance ($g_p$, $g_c$). Direct path models were found between need for cognition and cognitive engagement as well as need for cognition and cognitive performance. However, these results were limited to a cross-sectional design and relatively young sample (approximately half were 18-30 years).

**Need for cognition.** Need for cognition was originally defined by Cohen et al. (1955) as “a need to structure relevant situations in meaningful, integrated ways. It is a need to understand and make reasonable the experiential world” (Cohen et al., 1955, p. 291). Cohen’s description of a need refers to “feelings of tension and frustration” (Cohen et al., 1955, p. 291). These feelings of tension direct an individual to engage in behavior toward a goal of increasing understanding (Cohen et al., 1955). A small sample of 57 males was used to assess the effects of ambiguity in people with different levels of need with two independent measures. A measurable need was confirmed by the consistency between the two measures. However, there was no relationship between need for cognition and need for achievement (Cohen et al., 1955).

In 1982, Cacioppo and Petty broadened Cohen’s concept of need for cognition in an effort to “identify differences among individuals in their tendency to engage in and enjoy thinking” (p. 116). A series of four studies were conducted consisting of varied samples of university faculty, undergraduate students, and assembly line workers to develop an instrument to measure an individual’s need for cognition. A 34 item scale was developed and supported by
replication and factor analysis and was found to be positively associated with intelligence (self-reported ACT scores). Two years later, the scale was further reduced to 18 items (Cacioppo et al., 1984). From 1982 to 1996, 30 separate studies were conducted utilizing the Need for Cognition Scale (NCS) (Cacioppo, Petty, Feinstein, & Jarvis 1996). In an effort to further develop the theory of need for cognition, Cacioppo et al. (1996) reviewed these studies and found supportive evidence for the following: additional source of variance in need for cognition was related to individual differences, individuals high in cognition tend to seek information and reflect on information to understand their world, while those low in cognition tend to rely on other people for information and to make sense of the world. Individuals high in cognition consider cognitive activities enjoyable rather than work that must be done. As of 1996, how or if need for cognition was related to any of the five factors of personality had yet to be methodically studied (Cacioppo et al., 1996).

In 2008, a replication study was conducted with 214 undergraduate students examining the relationship between self-reported GPA, life satisfaction, and need for cognition (Dwyer, 2008). Although no relationship was found between life satisfaction and need for cognition, a significant relationship was found between GPA and life satisfaction as well as a greater relationship between GPA and need for cognition. This research provided evidence of need for cognition as a possible predictor of academic performance.

A study by Hill et al. (2013) used measures of intelligence, specifically the Wechsler Adult Intelligence Scale (WAIS-III) and Raven’s Advanced Progressive Matrices (RAPM), and the NCS to determine the relationship between need for cognition and crystallized ($g_c$) and fluid intelligence ($g_f$). Using structural equation modeling and zero-order correlations, need for cognition was found to be positively associated with both $g_f$ and $g_c$. These findings suggest
possible “associations between trait-level individual differences, such as need for cognition, and intelligence test performance” (Hill et al., 2013, p. 25).

Finally, Olson, Camp, and Fuller (1984) utilized the NFS and eight different measurements of curiosity to examine the relationship between need for cognition and curiosity. Among 140 undergraduate students, the researchers found need for cognition to be positively related to all measures of curiosity except for diversive curiosity. Although Consultation and Observation subscales were positively correlated, the highest correlation was found between need for cognition and the Thinking response subscale. Need for cognition was also found to be positively correlated with ACT scores.

**Curiosity and exploration.** Research related to curiosity and exploration as defined by Berlyne (1954, 1960) abounds. Litman and Spielberger (2003) developed a questionnaire to assess epistemic and perceptual curiosity and determine if clear differences existed between the two constructs. This measure was administered to 739 undergraduate students in addition to other measures of State-Trait personality, sensation seeking, and novelty. Factor analysis was used to identify factors of epistemic and perceptual curiosity, each with clear, distinct structures (Litman & Spielberger, 2003). Berlyne’s theoretical constructs of curiosity were confirmed through the identification of two components of epistemic curiosity related to diversive and specific behavior. Litman and Spielberger (2003) recommended investigation into the relationships between epistemic curiosity and factors of personality as well as the predictive value of epistemic curiosity for individual differences in intellectual engagement. Since 2003, Litman has been one of the foremost researchers in curiosity, particularly epistemic and its relation to interest and deprivation as well as the development and revision of numerous measures of curiosity (Litman, 2008; Litman & Jimerson, 2004; Mussel et al., 2012).
Kashdan et al. (2004) sought to develop instrumentation to assist in the understanding of the role curiosity plays in personal growth opportunities. Five independent samples were used to “assess the exploration and absorption components of curiosity” (Kashdan et al., 2004, p. 293). Other curiosity scales and big five personality assessments were used to establish convergent and discriminant validity. Findings included curiosity’s positive association with tendency to enjoy cognitive activities and openness to new experiences as well as positive assessments of “self, world, and future” (Kashdan et al., 2004, p. 301). Negative associations were found between curiosity and apathy, social anxiety, and boredom.

The role of curiosity in “global decision-making” (Harvey et al., 2007. p. 43) in the field of business was also considered using Berlyne’s (1960) theory. Harvey et al. (2007) developed a six-step process for raising a global manager’s level of curiosity. Although the paper and steps outlined therein were theoretical in nature, it demonstrates the applicability of curiosity theory outside the psychological or educational fields.

In 2013, Mussel proposed a “theoretical framework for the structure of personality traits related to intellectual achievements” (p. 885) using six constructs: need for cognition, typical intellectual engagement, intrinsic motivation, openness to ideas, epistemic curiosity, and goal orientation. Three studies were conducted using a 24-item scale measuring each of the six constructs. Overall findings indicated the six constructs could be integrated into one framework of Intellect, consisting of two dimensions: Process and Operation (Mussel, 2013). Process refers to motivational aspects of intellect such as seeking, openness, effort, and persistence. Operation refers to cognitive abilities such as problem solving, decision making, thinking, learning, and creating. Mussel (2013) suggested the findings support a new framework of exploring intellect.
for predicting performance in educational and job related areas as well as counseling and development.

**Big five personality domains.** Although Cattell (1947, 1987) proposed a 16 factor structure of personality, it was Tupes and Christal (1961) who discovered five “recurrent factors” (p. 11) of personality: (a) Surgency (Extroversion), (b) Agreeableness, (c) Dependability (conscience), (d) Emotional Stability, and (e) Culture (Openness or Intellect). This five factor structure was also supported by Goldberg (1990), McCrae and Costa (1987), DeYoung et al., 2007, and John and Srivastava (1999), but continued to be criticized by Cattell (1995) as a theory appealing to “those untrained in ‘state-of-the-art’ multivariate experimental psychology” (p. 207). However, the five-factor model was derived by means of factor analysis and verified through not only factor analysis, but also structural equation modeling in the previously mentioned articles. In 2003, the five-factor model was used with critical thinking, abstract reasoning, and Myers-Briggs type assessments to determine the predictability of intelligence by personality, gender, and age (Moutafi, Furnham, & Crump, 2003). The study of 900 participants found intelligence to be most highly correlated with the Big-Five factors of Openness and Conscientiousness and with Intuition and Sensing from the Myers-Briggs (Moutafi et al., 2003). Furthermore, significant five factor predictors of intelligence were Neuroticism, Extraversion, Openness, and Conscientiousness, accounting for 5% of the variance in critical thinking scores. These results supported Cattell’s investment theory connection between personality and intelligence. Further support of Cattell’s theory, with a five-factor model, was a study by Nusbaum and Silvia (2011). This study examined 188 young adults on the relationship between Openness/Intellect (as two separate aspects) and fluid intelligence, and creative behavior and
achievement. Openness was found to significantly predict creativity, but not fluid intelligence. Intellect significantly predicted fluid intelligence, but not creativity (Nusbaum & Silvia, 2011).

**Defining Intellectual Curiosity**

Previous researchers sought to establish the term *intellectual curiosity* as “tendencies to seek out, engage in, enjoy, and pursue opportunities for effortful cognitive activity” (von Stumm et al., 2011, p. 577). The meta-analytic study suggested intellectual curiosity is a core determinant of academic performance and may encompass intelligence, openness, and conscientiousness. The studies within the meta-analysis employed measures of Typical Intellectual Engagement (TIE), personality, and intelligence to predict academic performance evidenced by GPA. Previous research (von Stumm et al., 2011) used a meta-analytically derived correlation matrix to run a series of path models of factors predicting academic performance. The purpose of the study was to derive a predictor in the form of intellectual curiosity. The researchers used TIE as a “represented construct for intellectual curiosity…because it has been more frequently employed in research in intelligence, personality and academic performance than other investment scales” (von Stumm et al., 2011, p. 578). Interestingly, measures of need for cognition and epistemic curiosity were not utilized. Although von Stumm et al. described an “association of intellectual curiosity with academic performance” (2011, p. 582), the path models indicated TIE, intelligence, and conscientiousness were “direct, intercorrelated predictors of academic performance… [and] supported that intellectual investment is a key determinant of academic performance” (p. 582). In view of the current reported results, it is unclear how the association between intellectual curiosity and academic performance was determined, especially without a direct measure of epistemic curiosity.
In a 2013 concept analysis, Russell completed a cross-disciplinary review of literature for intellectual curiosity and reported only one source (a dissertation) specifically addressing intellectual curiosity. The 1996 dissertation (Cyr) used a qualitative case study approach with instructors and students at the Air Force Academy to determine the meaning of intellectual curiosity, a requirement for admission to the academy. Cyr found the meaning of intellectual curiosity to be unclear, but most often interpreted as an attitude, a drive, a cognitive outcome, critical thinking, and students’ motivation to go beyond basic curriculum requirements or a combination of all concepts. An academy instructor handbook identified intellectual curiosity as an “attitude that predisposes a person toward lifelong learning” (Cyr, 1996, p.80). Although this attitude was a requirement at the academy, Cyr’s research indicated no formal definition of the construct and no method of assessing it. Based on Cyr’s dissertation and the literature review, Russell (2013) formed a theoretical definition in which intellectual curiosity “requires a motivational state of cognitive stimulation with resultant exploratory behavior to acquire new knowledge or seek clarification in understanding” (p. 100). Individual differences influence the process of intellectual curiosity. Cognitive stimulation and the extent to which a student explores may be influenced by the student’s desire to acquire new knowledge (Russell, 2013). The degree of understanding is also influenced by the individual’s value of knowledge. The lack of empirical support for, yet educationally expected idea of intellectual curiosity indicates a need for formal definition. An empirically derived definition of intellectual curiosity may assist educators with identifying student characteristics that demonstrate intellectual curiosity and may provide a research based decision making process regarding a student’s drive to be successful in a program of higher education.
Considering the suggestive findings of researchers such as von Stumm et al. (2011) and Mussel (2013), the current study proposes an integration of intellectual investment and curiosity theories, relative to the intellectual engagement, need for cognition, curiosity, and the five big factors of personality to formulate a model of intellectual curiosity.

**Chapter Summary**

Chapter II detailed the history of curiosity from philosophical, psychological, and educational perspectives as well as the history of intelligence. Theoretical constructs of Cattell’s (1943, 1957) theory of intelligence and Berlyne’s (1954, 1960) theory of curiosity were discussed for integration into a theoretical framework for empirically defining intellectual curiosity. Cattell’s (1943) theory of intelligence posited the existence of two types of intelligences: Fluid and Crystallized, each comprised of specific abilities of reasoning, problem solving, and performance. Although each type of intelligence begins at birth, crystallized abilities acquired within a culturally dependent environment are developed from the investment of biological fluid abilities (Cattell, 1987). An interaction between intelligence and personality produces age-related changes in cognitive performance, and determines the way mental abilities are applied (Boyle et al., 1995; Cattell, 1943). Berlyne’s (1954, 1960) theory of curiosity posited a drive to seek new information by means of exploration or exploratory behavior. In relation to Berlyne’s description of a curiosity drive, Cattell’s theory of intelligence suggested curiosity is stimulated by a feeling of arousal, or ergic tension (Cattell, 1957), caused by an individual’s realization of a conflictive gap in knowledge. Although Berlyne’s theory of curiosity did not consider the impact of personality characteristics, with the integration of Cattell’s theory of intelligence used within this study, the two theories contribute to the identification of intellectual
curiosity. The chapter also presented a review of current literature and previous research related to curiosity and the development of the concept of intellectual curiosity.
CHAPTER III

METHODOLOGY

Chapter III presents detailed information regarding the research question, research design, study participants, instrumentation, statistical procedures, and data analyses. A summary of the chapter is also presented. The purpose of this study is to identify and establish a clear definition of intellectual curiosity generated by the strong framework established for the study and empirically driven by examining the interrelationships between curiosity, thinking, and intellectual engagement as defined by Cattell (1943, 1957, 1987) and Berlyne (1954, 1960, 1962).

Research Question

The theoretical framework posited in Chapters I and II provide the impetus for the research question for the study. The essence of the framework posits that by integrating the theoretical constructs of Berlyne’s curiosity theory (1960) and Cattell’s intellectual investment theory (1987), an empirical definition for intellectual curiosity can be developed for use in future research. Based on this strong framework premise the following research question was generated for study:

Will an empirical examination of the interrelationships among the constructs posited by Cattell and Berlyne such as curiosity, thinking, and intellectual engagement provide an empirically valid definition of intellectual curiosity?

Research Design

An ex post facto research design focused on correlational and factor analysis approach to defining intellectual curiosity was utilized in the current study. Constructs identified in the theoretical framework were represented by specified variables and presented for consideration by
study participants within the context of the overriding theories posited in the framework. Participants responding to self-report instrumentation provided the empirical perceptions for determining the relationships among identified factors. Specific variables identified from the framework include thinking, exploratory behavior, and intellectual engagement and were explored using appropriate data analyses for aligning conceptually with the work of Cattell (1943, 1957, 1987) and Berlyne (1954, 1960, 1962).

**Participants**

Study participants consisted of 822 undergraduate students at a 4-year university in the southeastern region of the United States. Based on a student population of 12,000 to 15,000, with a 95% confidence level and a 5% margin of error, a sample size of approximately 400 students was necessary to accurately reflect the target population. IRB approval and informed consent were obtained prior to the initiation of the study. After obtaining a random sample of faculty members, emails were sent to the faculty members requesting participation from one of their class meetings for study participation. Of the 55 faculty members emailed, 16 responded and allowed data collection from their face-to-face classes via paper and pencil assessments. Five faculty members sent the URL link for online participation to their online students.

**Data Collection and Procedures**

Two co-investigators, approved by the institutional review board, served as the data collectors within the classrooms of faculty members who agreed to allow their classes the option to participate in the study. The co-investigators ensured the anonymity and confidentiality of the research participants by (1) remaining in the classroom with the students to prevent undue coercion by the instructor and (2) to separate the signed informed consent forms from the participants’ survey responses prior to review by the Principal Investigator. Surveys were
administered after securing informed consent for participation in the research study. Participants were informed that study participation was voluntary and all data and results would remain confidential.

**Sampling**

Undergraduate college students within a regional university voluntarily participated in the current study. Informed consent (Appendix A) was obtained and participants were selected through convenience sampling procedures to obtain 822 undergraduate students. Of the 995 students enrolled in the face-to-face courses, 738 agreed to participate, resulting in a 74% response rate. Of the five faculty members who emailed the URL to students, 108 undergraduate students completed the online survey. The same informed consent form was used for face-to-face and online participation. Of the total sample of 822 undergraduate students, 13% completed the survey online.

**Permissions**

Approval to conduct the study was obtained from the Institutional Review Board (Appendix B). Informed consent was obtained (Appendix A) from each of the online and face-to-face student participants prior to participation.

**Instrumentation**

Three self-report instruments were used to measure the specific variables identified in the theoretical framework posited for the study: the *Curiosity and Exploration Inventory*, the *Need for Cognition Scale*, and the *Big Five Inventory*. Although all instruments are public domain access and use and permissions to use these three instruments were not required for this study, permissions were obtained from each of the instruments’ authors and are located in the Appendices (Appendix C-E).
**Curiosity and Exploration Inventory (CEI-II).** The CEI-II (Appendix F) is a self-report assessing “the degree to which people tend to seek out new knowledge and experiences, as well as their willingness to tolerate the novelty and uncertainty of their environment” (Kashan et al., 2009, p. 91). The measure consists of 10 items with two factors: the motivation to seek out knowledge and challenging, new experiences (Stretching), and a willingness to embrace the novel, uncertain and unpredictable nature of everyday life and be deeply engaged in activities (Embracing). Participants rate items using a 5-point Likert-type scale. The CEI-II has strong internal reliability with an alpha coefficient = .86. Evidence of validity has been demonstrated in diverse populations in laboratory (Silvia, 2005, 2008), cross-sectional (Gallagher & Lopez, 2007) and daily diary studies (Kashdan & Steger, 2007) “over and above the overlapping constructs of positive affect and reward sensitivity” (Kashdan et al., 2009).

**Validity.** Validity for the CEI-II was established using Confirmatory Factor Analysis (CFA), producing the two factor (stretching and embracing) structure. The non-normed fit index (NNFI) was reported to be .96 and the Comparative Fit Index (CFI) was reported to be .97 (Kashdan et al., 2009, p. 991). Previous studies (Gallagher & Lopez, 2007; Kashdan et al., 2004; Kashdan & Steger, 2007; Silvia, 2005, 2008) also found the instrument to have convergent, construct, and discriminant validity.

**Reliability.** The CEI-II evidenced acceptable internal consistency by an overall Cronbach alpha value of .86 and inventory items did not demonstrate multicollinearity (Kashdan et al., 2009, pp. 991-992). Internal reliability for each subscale was also acceptable for stretching ($\alpha = .80$) and embracing ($\alpha = .79$).
**Need for Cognition Scale (NCS).** The short form of the NCS (Cacioppo, Petty, & Kao, 1984) consists of 18 items, using a 5-point Likert-type scale. The NCS (Appendix G) measures "the tendency for an individual to engage in and enjoy thinking" (Cacioppo & Petty, 1982, p. 116). Initially developed as a 34-item scale, in 1984, a new study was conducted and data were factor analyzed to reduce the number of items from 34 items to 18 items and “enhance its efficiency” (Cacioppo et al., p. 306).

**Validity.** Four different studies were conducted to validate the original 34-item scale, which utilized factor analyses to yield 10 factors, the first of which accounted for 27% of the variance and was thus determined to be the dominant factor. In 1984, this factor was found to account for 37% of the variance in the 18-item version. Although other factors accounted for approximately equal, but decreasing proportions of the remaining variance, only the first factor was retained following the scree test (Cacioppo & Petty, 1982; Cacioppo et al., 1984, p. 306). Convergent and discriminant validity were demonstrated via significant correlations resulting among the NCS and measures of cognitive style as well as non-significant correlations with test anxiety. Predictive validity was evidenced by participants’ high scores/responses focused in the need for cognition to enjoy tasks that are more complex.

**Reliability.** Reliability for the 18-item NCS was demonstrated by a Cronbach alpha coefficient reported = .90 (Cacioppo et al., 1984, p. 306). The original 34-item NCS had an internal consistency of α = .91 as well as acceptable statistical significance (p < .001) in the split-half reliability test (Cacioppo & Petty, 1982, p.119). According to Cacioppo and Petty (1982), both versions of the NCS correlated “high and significantly (r = .95, p < .001)” (p. 306).

**Big Five Inventory (BFI).** The BFI (John et al., 1991; Appendix H) is a self-report instrument assessing five dimensions of personality: extraversion, agreeableness,
conscientiousness, neuroticism, and openness to experience. The measure consists of 44 items and participants’ rating items using a 5-point Likert-type scale (1 = strongly disagree, 5 = strongly agree). The BFI has strong internal reliability with a resulting Cronbach alpha coefficient = .83.

Validity. Convergent and discriminant validity for the BFI were established using confirmatory factor analysis (CFA; John & Srivastava, 1999). The BFI was compared to two other big five instruments, namely the Trait Descriptive Adjectives (TDA; Goldberg, 1992) and the NEO Personality Inventory (Costa & McCrae, 1985, 1992b), both of these instruments are much longer inventories than the BFI (100 and 240 items, respectively). Convergent validity and overall CFA outcomes for the BFI are displayed in Table 1. Discriminant validity of the BFI was evidenced by the low intercorrelation range (.08 - .13) across the instrument’s subscales (Rammstedt & John, 2007).

Table 1

Convergent Validity Coefficients for the TDA, NEO, and BFI

<table>
<thead>
<tr>
<th>Measure</th>
<th>Extra-version</th>
<th>Agreeableness</th>
<th>Conscientiousness</th>
<th>Neuroticism</th>
<th>Openness</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFI-TDA</td>
<td>.90</td>
<td>.78</td>
<td>.81</td>
<td>.76</td>
<td>.75</td>
<td>.81</td>
</tr>
<tr>
<td>BFI-NEO</td>
<td>.83</td>
<td>.97</td>
<td>.96</td>
<td>.90</td>
<td>.85</td>
<td>.92</td>
</tr>
<tr>
<td>Mean</td>
<td>.93</td>
<td>.92</td>
<td>.94</td>
<td>.88</td>
<td>.83</td>
<td>.91</td>
</tr>
<tr>
<td>BFI</td>
<td>.94</td>
<td>.92</td>
<td>.92</td>
<td>.90</td>
<td>.92</td>
<td>.92</td>
</tr>
<tr>
<td>TDA</td>
<td>.95</td>
<td>.85</td>
<td>.87</td>
<td>.83</td>
<td>.79</td>
<td>.87</td>
</tr>
<tr>
<td>NEO</td>
<td>.68</td>
<td>.83</td>
<td>.86</td>
<td>.84</td>
<td>.70</td>
<td>.79</td>
</tr>
<tr>
<td>Mean</td>
<td>.90</td>
<td>.87</td>
<td>.89</td>
<td>.86</td>
<td>.83</td>
<td>.87</td>
</tr>
</tbody>
</table>


*p < .05.
Reliability. Internal consistency was demonstrated by a resulting Cronbach Alpha = .83 (John & Srivastava, 1999). Cronbach’s alpha reported values for each subscale are as follows: extraversion = .88; agreeableness = .79; conscientiousness = .82; neuroticism = .84; and openness to experience = .81. Three month test-retest reliability ranged from .80 to .90 (John & Srivastava, 1999, p. 115).

Data Analysis

The purpose of the study was to examine the interrelationships between curiosity, thinking, and intellectual engagement based on the framework of Cattell (1943, 1957, 1987) and Berlyne (1954, 1960, 1962) established for this study. Descriptive statistics, correlational analyses, and independent t tests were conducted using SPSS, version 22 (IBM Corp., 2013). Correlational analyses were performed to determine the relationship between each of the eight subscales. Independent t tests were used to compare students’ level of cognition (high versus low) relative to certain characteristics (conscientiousness, openness, and curiosity). An exploratory factor analysis was performed for this study using Mplus, version 7.4 (Muthen & Muthen, 1998, 2015). Exploratory Factor Analysis (EFA) was used to evaluate the factor structure among test items across the three quantitative instruments to define the content of intellectual curiosity.

Chapter Summary

This chapter details the methods used for data collection and analyses. A single research question guided this study: Will an empirical examination of the interrelationships among the constructs posited by Cattell and Berlyne such as curiosity, thinking, and intellectual engagement provide an empirically valid definition of intellectual curiosity? The Curiosity and Exploration
Inventory (CEI-II) was used to assess individual differences in participants’ recognition, pursuit, and integration of novel and challenging experiences and information. The Need for Cognition Scale (NCS) was used to measure participants’ propensity to engage in and enjoy intellectual activities. Finally, the Big Five Inventory (BFI) was used to measure five dimensions of personality related to participants’ interests and traits. Reliability and validity have been established and each instrument is appropriate for utilization within the current study. Each instrument was administered either face-to-face in undergraduate college classrooms or via a URL link to the online survey. Once data were collected, an exploratory factor analysis was performed to determine the number of factors measuring curiosity, thinking, and intellectual engagement and whether those factors combine to create a path model of intellectual curiosity. Results of the data analyses are discussed in Chapter IV: Results.
CHAPTER IV

RESULTS

Chapter IV consists of the results obtained by the study. The chapter includes (a) a description of the sample obtained for study; (b) the data screening procedures; and (c) the results of the statistical analyses performed for the study. A discussion of the results pertinent to the research questions is also presented. The purpose of this study was to identify and establish a definition of intellectual curiosity by answering the question: Will an empirical examination of the interrelationships among the constructs posited by Cattell and Berlyne such as curiosity, thinking, and intellectual engagement provide an empirical definition of intellectual curiosity?

Resulting Demographics for the Sample

Approximately 55 faculty members from a regional university located in the southeastern area of the United States were randomly selected and contacted for the purpose of requesting permission for access to classrooms of undergraduate students for recruiting students for participation in the study. Sixteen faculty members agreed to allow face-to-face classroom access for recruiting student participation and five faculty members agreed to allow online access for recruiting student participation. Seven hundred and thirty eight students participated in face-to-face completion of the study survey instrument with 721 face-to-face students providing completed survey forms. One hundred and sixteen students participated in the completion of the online version of the study survey instrument with 108 students providing complete survey forms for a total of 829 study instruments completed by undergraduate college students. Questionnaire length (72 items) and survey fatigue was conjectured as the attributing factor to study attrition (Berdie, 1973; Bogen, 1996; Porter, Whitcomb, & Weitzer, 2004). The sample of undergraduate students who agreed to participate in the current study is statistically representative of the
undergraduate student body of the regional university as indicated by the parallel demographic
data presented in Table 2. Data derived from this study may not be characteristic of the average
American university undergraduate student. Table 2 describes the demographic characteristics of
the sample. The majority of the participants in the study were female (57%) and were between
the ages of 18 and 24 (84%).

Table 2

Resulting Demographics of Study Participants and the Existing Regional University
Demographics

<table>
<thead>
<tr>
<th>Undergraduates</th>
<th>Study participants</th>
<th>Regional university</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( N = 822 )</td>
<td>( N' = 10,072 )</td>
</tr>
<tr>
<td></td>
<td>( n )</td>
<td>( % )</td>
</tr>
<tr>
<td>Gender(^{b})</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>351</td>
<td>43.0</td>
</tr>
<tr>
<td>Female</td>
<td>469</td>
<td>57.0</td>
</tr>
<tr>
<td>Age(^{c}) (( M = 23 ))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-24</td>
<td>692</td>
<td>84.2</td>
</tr>
<tr>
<td>25-29</td>
<td>57</td>
<td>7.0</td>
</tr>
<tr>
<td>30-34</td>
<td>16</td>
<td>2.0</td>
</tr>
<tr>
<td>35-39</td>
<td>19</td>
<td>2.3</td>
</tr>
<tr>
<td>40-49</td>
<td>28</td>
<td>3.4</td>
</tr>
<tr>
<td>50-64</td>
<td>8</td>
<td>1.0</td>
</tr>
<tr>
<td>65 and older</td>
<td>1</td>
<td>&lt; 1.0</td>
</tr>
</tbody>
</table>

61
Table 2

**Resulting Demographics of Study Participants and the Existing Regional University Demographics (continued)**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Study participants</th>
<th>Regional university</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 822</td>
<td>N(a) = 10,072</td>
</tr>
<tr>
<td>Freshman</td>
<td>160 19.0</td>
<td>1713 17.0</td>
</tr>
<tr>
<td>Sophomore</td>
<td>151 18.0</td>
<td>1501 15.0</td>
</tr>
<tr>
<td>Junior</td>
<td>300 37.0</td>
<td>2543 25.0</td>
</tr>
<tr>
<td>Senior</td>
<td>193 24.0</td>
<td>3934 39.0</td>
</tr>
<tr>
<td>Unclassified</td>
<td>17 2.0</td>
<td>413 4.0</td>
</tr>
</tbody>
</table>

*Note.* N = 822.

\(a\) Demographics of local university undergraduate students (NCES, 2014). \(b\) Two students did not report gender. \(c\) One student did not report age. \(d\) One student did not report classification.

**Data Screening**

Based on recommendations by Tabachnick and Fidell (2007), data screening was conducted in SPSS, version 22 (IBM Corp., 2013) to determine if data met assumptions for multivariate analysis, including normality, linearity, and homoscedasticity. An examination of frequency distributions and descriptive statistics analyses revealed no missing values. Scatter and boxplots were used to examine univariate outliers for each of the eight subscales. Seven extreme outlier responses were identified and were determined to result from participants marking all positive or all negative responses. The outlier responses were removed from the dataset, resulting in 822 undergraduate student responses for analyses. Following the removal of the extreme outliers, resulting frequency distributions followed normality considerations.
Other data screening procedures included additional examinations of raw data plots. Linearity assumes “a straight-line relationship between two variables” (Tabachnick & Fidell, 2007, p. 83) and is evaluated from either residual plots or bivariate scatterplots. The assumption of homoscedasticity emphasizes that the variability in scores from one variable is approximately the same as variability in scores from another variable (Tabachnick & Fidell, 2007). Both homoscedasticity and linearity were assessed by inspecting bivariate scatterplots among all combinations of variables. Results of these homoscedasticity and linearity assessments indicated no variable pairs with significant violations of homoscedasticity and all variable pairs demonstrated linear relationships. Multivariate outliers were examined using the calculation of Mahalanobis distance (Tabachnick & Fidell, 2007). No outliers were detected using an alpha level (.001), as recommended by Tabachnick and Fidell (2007). Multicollinearity was also examined using the collinearity diagnostics function in SPSS. Results of the collinearity diagnostics indicated no multicollinearity was evident.

**Review of Instrumentation**

Three self-report instruments were used to measure the specific variables identified in the theoretical framework posited for the study: the Curiosity and Exploration Inventory-II, the Need for Cognition Scale, and the Big Five Inventory. The following sections offer a brief review of each of the instruments prior to a discussion of the statistical analyses.

**Curiosity and Exploration Inventory (CEI-II).** The CEI-II is a self-report instrument that assesses “the degree to which people tend to seek out new knowledge and experiences, as well as their willingness to tolerate the novelty and uncertainty of their environment” (Kashan et al., 2019, p. 91). The measure consists of 10 items with two factors: the motivation to seek out knowledge and challenging, new experiences (stretching), and a willingness to embrace the
novel, uncertain, and unpredictable nature of everyday life and be deeply engaged in activities (embracing).

**Need for Cognition Scale (NCS).** The short form of the NCS (Cacioppo et al., 1984) consists of 18 items, assessing a single factor. The NCS measures "the tendency for an individual to engage in and enjoy thinking" (Cacioppo & Petty, 1982, p. 116).

**Big Five Inventory (BFI).** The BFI (John et al., 1991) is a 44-item self-report instrument assessing five dimensions of personality: extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience. Each of the five dimensions represents one of the instrument’s subscales.

Combining the three instruments, there were eight subscales for this study: (a) stretching; (b) embracing (Curiosity and Exploration Inventory (CEI)-II); (c) the Need for Cognition Scale (NCS); (d) openness; (e) conscientiousness; (f) extraversion; (g) agreeableness; and (h) neuroticism (the Big Five Inventory [BFI] subscales). A discussion of the quantitative analyses follows, addressing the purpose and outcome for each analysis.

**Quantitative Analyses**

Several quantitative analyses were conducted using the raw dataset from the 822 forms collected from the undergraduate students. Quantitative analyses included correlation, exploratory factor analysis, reliability analysis, and independent t test analysis.

**Correlations.** Correlation analyses were performed to examine relationships among the eight subscales. Although significant correlations were demonstrated among all eight subscales except Openness with Agreeableness ($r = .06, p = .07$) and Openness with Neuroticism ($r = -.00, p = .97$), there was no evidence of multicollinearity (Belsley, Kuh, & Welsch, 2005) between subscales, suggesting that each subscale measures related, but distinct constructs. Table 3
summarizes the means and standard deviations of each subscale and Table 4 summarizes the resulting correlations among each pair of the eight subscales.

Table 3

*Means and Standard Deviations for Scores on the NCS, and the Subscales for the CEI-II and BFI*

<table>
<thead>
<tr>
<th>Subscale</th>
<th>NCS</th>
<th>CEI-II (overall)</th>
<th>CEI-II Stretching</th>
<th>CEI-II Embracing</th>
<th>E</th>
<th>A</th>
<th>C</th>
<th>N</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>M</em></td>
<td>62.28</td>
<td>37.90</td>
<td>15.39</td>
<td>17.91</td>
<td>3.29</td>
<td>3.97</td>
<td>3.80</td>
<td>2.74</td>
<td>3.64</td>
</tr>
<tr>
<td><em>SD</em></td>
<td>11.03</td>
<td>6.59</td>
<td>2.58</td>
<td>4.08</td>
<td>.79</td>
<td>.59</td>
<td>.60</td>
<td>.78</td>
<td>.59</td>
</tr>
</tbody>
</table>

*Note. N = 822. NCS = Need for cognition scale; CEI-II = Curiosity and exploration inventory; BFI = Big five inventory; E = Extraversion subscale; A = Agreeableness subscale; C = Conscientiousness subscale; N = Neuroticism subscale; O = Openness subscale.*

The relationships of particular interest to the current study are need for cognition, conscientiousness, curiosity, and openness. Previous research (Sadowski & Cogburn, 1997) has indicated a positive association between need for cognition and conscientiousness. These findings were consistent with the current study’s finding of a low, but significant association between need for cognition and conscientiousness ($r = .29, p < .01$). Need for cognition was also related to openness ($r = .54, p < .01$) as found in previous research (Kashdan et al., 2004; von Stumm, 2013). Curiosity was also related to need for cognition ($r = .54, p < .01$) which confirms previous research findings (Olson et al., 1984). In addition, curiosity was related to conscientiousness ($r = .23, p < .01$) and openness ($r = .48, p < .01$).
Table 4

Summary of Intercorrelations for Scores on the NCS, and the Subscales for the CEI-II, and BFI

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. NCS</td>
<td>.54**</td>
<td>.54**</td>
<td>.33**</td>
<td>.08*</td>
<td>.12**</td>
<td>.29**</td>
<td>-.09**</td>
<td>.54**</td>
<td></td>
</tr>
<tr>
<td>2. CEI-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>.37**</td>
<td>.25**</td>
<td>.23**</td>
<td>-.23**</td>
<td>.48**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. CEI-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stretching</td>
<td>.58**</td>
<td>.52**</td>
<td>.21**</td>
<td>.25**</td>
<td>-.14**</td>
<td>.42**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. CEI-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embracing</td>
<td>.39**</td>
<td>.22**</td>
<td>.09**</td>
<td>-.24**</td>
<td>.36**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BFI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. E</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.19**</td>
<td>.13**</td>
<td>-.27**</td>
<td>.15**</td>
</tr>
<tr>
<td>6. A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.37**</td>
<td>-.32**</td>
<td>.06</td>
<td></td>
</tr>
<tr>
<td>7. C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.30**</td>
<td>.08*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-.00</td>
<td></td>
</tr>
<tr>
<td>9. O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. N = 822. NCS = Need for Cognition Scale; CEI-II = Curiosity and Exploration Inventory; BFI = Big Five Inventory; E = Extraversion subscale; A = Agreeableness subscale; C = Conscientiousness subscale; N = Neuroticism subscale; O = Openness subscale. * p < .05. ** p < .01.

**Exploratory factor analysis.** The Curiosity and Exploration Inventory-II assessed students’ drive to seek out knowledge and new experiences as well as the propensity to embrace “the unpredictable nature of everyday life” (Kashdan et al., 2009). The Need for Cognition Scale was used to measure the students’ “tendency to engage in and enjoy thinking” (Cacioppo et al., 1984, p. 306). The Big Five Inventory (John & Srivastava, 1999) measured five dimensions of...
personality: (a) extraversion; (b) agreeableness; (c) conscientiousness; (d) neuroticism; and (e) openness to experience. Extraversion is related to such social traits as talkative, energetic, and assertive. Agreeableness is related to an individual’s level of trust and sympathy. Conscientiousness involves traits such as competence, organization, achievement, and self-discipline. Neuroticism is related to an individual’s emotional stability such as moodiness, anxiety, and irritability. Openness to experience, also known as intellect (Costa & McCrae, 1992b; Goldberg, 1990), is related to traits such as imaginative, curious, and insightful. Each of the three measures has been well established in the literature using confirmatory factor analysis.

The purpose of this study was to use an exploratory factor analysis (EFA) to explore the factor structure among test items across the three instruments in an effort to define the content of intellectual curiosity. The second goal of EFA relevant to this study was to consolidate the number of items related to the underlying structure necessary for measuring intellectual curiosity. A reduction from the 72 items used in this study may not only increase completion rates, but may also enhance the effectiveness of the measure by focusing attention on the common factors. Fowler (2009) stresses an important function of instrument design is to ensure the survey items function for the intended population and measure the intended construct. One of the purposes of exploratory factor analysis is to reduce the number of items to more effectively measure a particular construct or phenomenon (Floyd & Widaman, 1995).

A joint item EFA of the three instruments (72 items) was conducted with oblique rotation. The oblique rotation method was chosen because the factors were hypothesized to be correlated subscales of the higher order latent construct intellectual curiosity (Tabachnick & Fidell, 2007). Considerations were made with regard to the adequacy of the sample size. Comrey and Lee (1992) note sample sizes of “500—very good” and “1000—excellent” (p. 217).
Tabachnick and Fidell (2007) suggest, “a general rule of thumb…to have at least 300 cases for factor analysis” (p. 613). The ratio of number of participants to the number of variables or test items was 11:1 relative to a sample size of 822. The Kaiser-Meyer-Olkin (KMO; Kaiser, 1974) measure of sampling adequacy is an index used to examine the appropriateness of factor analysis. High values (between 0.5 and 1.0) indicate factor analysis is appropriate. Kaiser (1974) suggested values below 0.5 imply that factor analysis may not be appropriate and additional data collection may be necessary. The KMO value for the current study was .91, above the commonly recommended value of .6 (Tabachnick & Fidell, 2007). Factor analyses were performed using Mplus, version 7.4 (Muthen & Muthen, 2015) with maximum likelihood modeling (ML), using the raw scores for input. Factor analysis was performed to explore the factor structure among test items across the three instruments in an effort to define the content of intellectual curiosity.

A scree test, based on the guidelines suggested by Cattell (1966), was used to examine the number of factors for extraction. Both an eight and a nine-factor model were considered because the break in eigenvalues size occurs between the eighth and ninth factors (Figure 4).
A comparison of the pattern of correlations in the correlation matrix (see Table 4) with the produced factors (see Figure 4) revealed highly correlated variables loaded on the same factor and supported previous research findings. Factor loadings are shown in Table 5, with 47% of the total variance explained with the first eight factors. Tabachnick and Fidell (2007) suggested two “rules of thumb” (p. 649) for interpreting factor loadings: (a) “only variables with loadings of .32 and above are interpreted” (p. 649) and (b) “the greater the loading, the more the variable is a pure measure of the factor” (p. 649). Muthen and Muthen (2008) stipulate the ratio of the factor loading to the standard error indicate whether the factor loading is significantly different from zero and the item(s) should be retained. The magnitude of the loading “speaks to the practical significance of the loading” (Muthen & Muthen, 2008, para. 6). With these guidelines in mind, the highest loading items for each factor were examined with a cutoff of .40 and the ratio of the estimate to its standard error greater than 10.0. The cutoff criterion of .40 also assisted in the decision to retain eight factors.
Table 5

*Factor Loadings for Exploratory Factor Analysis with Oblique Rotation of BFI, CEI-II, and the NCS*

<table>
<thead>
<tr>
<th>Items</th>
<th>F1&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F2&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F3&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F4&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F5&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F6&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F7&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F8&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tends to be quiet.</td>
<td>.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is talkative.</td>
<td>.79</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is outgoing, sociable.</td>
<td>.74</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is reserved.</td>
<td>.72</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is sometimes shy, inhibited.</td>
<td>.66</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generates a lot of enthusiasm.</td>
<td>.55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is full of energy.</td>
<td>.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has an assertive personality.</td>
<td>.39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is relaxed, handles stress well.</td>
<td>.70</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worries a lot.</td>
<td>.64</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remains calm in tense situations.</td>
<td>.62</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gets nervous easily.</td>
<td>.60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is emotionally stable, not easily upset.</td>
<td>.59</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can be moody.</td>
<td>.50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can be tense.</td>
<td>.49</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is depressed, blue.</td>
<td>.41</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has an active imagination.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.66</td>
</tr>
</tbody>
</table>

70
Table 5

*Factor Loadings for Exploratory Factor Analysis with Oblique Rotation of BFI, CEI-II, and the NCS* (continued)

<table>
<thead>
<tr>
<th>Items</th>
<th>F1&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F2&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F3&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F4&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F5&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F6&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F7&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F8&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values artistic, aesthetic experiences.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.66</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is sophisticated in art, music, or literature.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is original, comes up with new ideas.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.56</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likes to reflect, play with ideas.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is inventive.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has few artistic interests.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is curious about many different things.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is ingenious, a deep thinker.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tends to be disorganized.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tends to be lazy.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does things efficiently.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.54</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Makes plans and follows through with them.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.52</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does a thorough job.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perseveres until the task is finished.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is a reliable worker.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Can be somewhat careless.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.43</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is easily distracted.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.41</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5

Factor Loadings for Exploratory Factor Analysis with Oblique Rotation of BFI, CEI-II, and the NCS (continued)

<table>
<thead>
<tr>
<th>Items</th>
<th>F1&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F2&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F3&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F4&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F5&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F6&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F7&lt;sup&gt;a&lt;/sup&gt;</th>
<th>F8&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>I like to have the responsibility of handling a situation that requires a lot of thinking.</td>
<td>0.72</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would prefer complex to simple problems.</td>
<td></td>
<td>0.66</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am at my best when doing something that is complex or challenging.</td>
<td></td>
<td></td>
<td>0.64</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.</td>
<td></td>
<td></td>
<td></td>
<td>0.64</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I prefer my life to be filled with puzzles that I must solve.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thinking is not my idea of fun.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>The notion of thinking abstractly is appealing to me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.55</td>
</tr>
<tr>
<td>I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.53</td>
</tr>
<tr>
<td>The idea of relying on thought to make my way to the top appeals to me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.53</td>
</tr>
<tr>
<td>I find satisfaction in deliberating hard and for long hours.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.48</td>
</tr>
</tbody>
</table>
Table 5

*Factor Loadings for Exploratory Factor Analysis with Oblique Rotation of BFI, CEI-II, and the NCS* (continued)

<table>
<thead>
<tr>
<th>Items</th>
<th>F1^a</th>
<th>F2^a</th>
<th>F3^a</th>
<th>F4^a</th>
<th>F5^a</th>
<th>F6^a</th>
<th>F7^a</th>
<th>F8^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>It’s enough for me that something gets the job done; I don’t care how or why it works.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.47</td>
</tr>
<tr>
<td>I really enjoy a task that involves coming up with new solutions to problems.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.46</td>
</tr>
<tr>
<td>Learning new ways to think doesn't excite me very much.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.46</td>
</tr>
<tr>
<td>I only think as hard as I have to.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.41</td>
</tr>
<tr>
<td>I like tasks that require little thought once I've learned them.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.37</td>
</tr>
<tr>
<td>I feel relief rather than satisfaction after completing a task that required a lot of mental effort.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.37</td>
</tr>
<tr>
<td>I actively seek as much information as I can in new situations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.36</td>
</tr>
<tr>
<td>I prefer to think about small, daily projects to long-term ones.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.29</td>
</tr>
<tr>
<td>I usually end up deliberating about issues even when they do not affect me personally.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.28</td>
</tr>
<tr>
<td>Is sometimes rude to others.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.67</td>
</tr>
<tr>
<td>Can be cold and aloof.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.59</td>
</tr>
<tr>
<td>Tends to find fault with others.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.50</td>
</tr>
<tr>
<td>Starts quarrels with others.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.50</td>
</tr>
</tbody>
</table>
Table 5

*Factor Loadings for Exploratory Factor Analysis with Oblique Rotation of BFI, CEI-II, and the NCS (continued)*

<table>
<thead>
<tr>
<th>Items</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>F4</th>
<th>F5</th>
<th>F6</th>
<th>F7</th>
<th>F8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has a forgiving nature.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is considerate and kind to almost everyone.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.48</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is helpful and unselfish with others.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likes to cooperate with others.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is generally trusting.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.37</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I prefer jobs that are excitingly unpredictably.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.66</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to do things that are a little frightening.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.63</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Everywhere I go, I am out looking for new things or experiences.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am the kind of person who embraces unfamiliar people, events, and places.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am always looking for experiences that challenge how I think about myself and the world.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.54</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5

*Factor Loadings for Exploratory Factor Analysis with Oblique Rotation of BFI, CEI-II, and the NCS* (continued)

<table>
<thead>
<tr>
<th>Items</th>
<th>F1^a</th>
<th>F2^a</th>
<th>F3^a</th>
<th>F4^a</th>
<th>F5^a</th>
<th>F6^a</th>
<th>F7^a</th>
<th>F8^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am the type of person who really enjoys the uncertainty of everyday life.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.51</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I frequently seek out opportunities to challenge myself and grow as a person.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I view challenging situations as an opportunity to grow and learn.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prefers work that is routine.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Factor loadings greater than .40 are shown in boldface.

^aFactor labels: F1 Extroversion; F2 Neuroticism; F3 Openness; F4 Conscientiousness; F5 Need for Cognition; F6 Agreeableness; F7 Trusting; F8 Curiosity and Exploration.

The items within each factor were scrutinized for unifying dimensions and each factor was labelled based on the common theme among items. Although some items were deleted, the overall subscale names remained intact. Curiosity and exploration, loaded onto one factor (in both the eight and nine factor models) rather than the two previously researched subscales of stretching and embracing (Kashdan et al., 2009; Kashdan, Sherman, Yarbro, & Funder, 2013; Ye, Ng, Yim, & Wang, 2015). One question from the agreeableness subscale of the BFI loaded as the only item on one factor; the loading was .30, below the .40 criterion established for the current study, and the item was eliminated from the model, thus resulting in seven factors.

Table 6 shows the model fit indices for both the eight and nine factor models. The Chi-Square model fit outcomes are described with caution to interpretation. The probability of less than .001 suggests inadequate model fit, thus requiring additional tests of fit. The Chi-Square statistic is sensitive to sample size and when large sample sizes are used, the Chi-Square statistic
often rejects the model (Bentler & Bonnet, 1980). In addition, although the overall model fit improves with the nine-factor model, the degrees of freedom are greatly reduced to less than three times the sample size (Tabachnick & Fidell, 2007). A common problem with interpreting Chi-Square as an index of model fit is the sensitivity to sample size, especially with sample sizes greater than 400, and an associated increase in Type I errors (Byrne, 2012; Kenny, Kaniskan, & McCoach, 2015; MacCallum, Browne, & Sugawara, 1996). Hu and Bentler (1999) describe the degree of model fit as a continuum, thus necessitating alternate indices to assess adequacy of model fit.

Table 6

Fit Indices for Exploratory Factor Models of the Measure of Intellectual Curiosity

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>df</th>
<th>CFI</th>
<th>RMSEA</th>
<th>CI (90%)</th>
<th>SRMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 Factors</td>
<td>1078.74***</td>
<td>2008</td>
<td>.91</td>
<td>.034</td>
<td>0.033 - 0.036</td>
<td>.026</td>
</tr>
<tr>
<td>9 Factors</td>
<td>363.70***</td>
<td>1944</td>
<td>.92</td>
<td>.032</td>
<td>0.031 - 0.034</td>
<td>.024</td>
</tr>
</tbody>
</table>

Note. $\chi^2$ = chi square goodness of fit statistic; df = degrees of freedom; CFI = comparative fit index; RMSEA = root-mean-square error of approximation; CI = confidence interval for RMSEA; SRMR = standardized square root mean residual. *** $p < .001$.

The three most commonly used indices of model fit are the Comparative Fit Index (CFI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR; Byrne, 2012; Hu & Bentler, 1999; Kline, 2011). These three indices are included in Table 6. The Comparative Fit Index (CFI) is an incremental measure of fit and consideration for specific sample size, has a value range between 0 and 1, with values closer to 1.0 indicating good fit (Hu & Bentler, 1999). The Root Mean Square Error of Approximation (RMSEA) is an absolute measure of fit and assesses “how well the hypothesized model fits the
sample data” (Byrne, 2012, p. 73) with a criterion of $\leq 0.06$ for good fit (Hu & Bentler, 1999). The RMSEA is useful because it is sensitive to model misspecification, yields appropriate conclusions about model quality, and yields confidence intervals around the RMSEA value (Byrne, 2012; Hu & Bentler, 1999). The Standardized Root Mean Square Residual (SRMR) is also a measure of absolute model fit and “represents the average discrepancy between the observed sample and hypothesized correlation matrices” (Byrne, 2012, p. 76). The SRMR has a value range of 0 to 1.0 with adequate model fit value $< .05$ (Byrne, 2012), but values as high as 0.08 are acceptable according to Hu and Bentler (1999). The SRMR value represents the “average discrepancy between the observed sample and hypothesized correlation matrices” (Byrne, 2012, p. 76). The current study’s SRMR = .026 can be interpreted as the eight factor model explaining the correlations to within an average error of .026.

Sobel and Bohrnstedt (1985) suggested that fit coefficients alone cannot judge “the adequacy of a model” (p. 158). Fit indices report a model’s lack of fit and not the “extent to which the model is plausible” (Byrne, 2012, p. 77). The decision of model adequacy must depend on the researcher’s judgment as well as “theoretical, statistical, and practical considerations” (Byrne, 2012, p. 77). The specified eight factor EFA model, although with minimally lower model fit values of $\chi^2$ (2008) = 1078.74, $p < .001$; CFI = .91; RMSEA = .03; and SRMR = .03, offered more adequate model fit over the nine factor model. Correlations among factors within acceptable range are shown in Table 7. In addition, the specified eight-factor model, once loading items below .40 were removed, offered seven factors and a total of 60 items. A discussion of the internal consistency for the seven factors is presented in the Psychometrics section.
Table 7

*Factor Correlations*

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Extroversion</td>
<td>- .26**</td>
<td>.11**</td>
<td>.10**</td>
<td>.08*</td>
<td>.17*</td>
<td>.37**</td>
<td></td>
</tr>
<tr>
<td>2. Neuroticism</td>
<td>.02</td>
<td>-.30**</td>
<td>-.10**</td>
<td>-.32**</td>
<td>-.23**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Openness/Creativity</td>
<td>.08*</td>
<td>.46**</td>
<td>.07</td>
<td>.37**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Conscientiousness</td>
<td>.30**</td>
<td>.33**</td>
<td>.18**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Need for Cognition</td>
<td>.14**</td>
<td>.49**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Agreeableness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.19**</td>
</tr>
<tr>
<td>7. Curiosity and Exploration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. N = 822.*  
* p < .05. ** p < .01.

**Psychometrics.** Following the determination of factors through EFA, internal consistency was estimated for each subscale using Cronbach’s alpha. The means, standard deviations, and alpha reliability coefficients for the eight subscales are reported in Table 8.
Means, Standard Deviations, and Reliability Statistics by Subscale

<table>
<thead>
<tr>
<th>Factor</th>
<th>Number of items</th>
<th>M (SD)</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>F₁ Extroversion</td>
<td>7</td>
<td>22.95 (5.83)</td>
<td>.86</td>
</tr>
<tr>
<td>F₂ Neuroticism</td>
<td>8</td>
<td>21.94 (6.25)</td>
<td>.82</td>
</tr>
<tr>
<td>F₃ Openness</td>
<td>7</td>
<td>25.64 (4.79)</td>
<td>.76</td>
</tr>
<tr>
<td>F₄ Conscientiousness</td>
<td>9</td>
<td>34.22 (5.40)</td>
<td>.78</td>
</tr>
<tr>
<td>F₅ Need for Cognition</td>
<td>15</td>
<td>53.35 (9.84)</td>
<td>.89</td>
</tr>
<tr>
<td>F₆ Agreeableness</td>
<td>6</td>
<td>23.52 (4.10)</td>
<td>.73</td>
</tr>
<tr>
<td>F₇ Curiosity and Exploration</td>
<td>8</td>
<td>30.07 (5.67)</td>
<td>.84</td>
</tr>
</tbody>
</table>

**Item elimination.** As a result of the EFA, the items listed in Table 9 were removed from the measure. The items are sectioned by the original measure from which they were derived.

Seven items remained representing the openness subscale and were positively correlated with curiosity ($r = .37$) as previous research has indicated (Kashdan et al., 2009; Mussel, 2010).

Curiosity is a fundamental component of openness to experience (John & Srivastava, 1999). In addition, with seven items remaining for extraversion, the subscale remained positively correlated with curiosity ($r = .37$) per previous research findings (Kashdan et al., 2009).

Extraversion is reported “to be a reflection of positive affectivity” (Kashdan et al., 2009, p. 992) which in previous literature has defined curiosity a positive affect (Fedrickson, 1998; Izard, 1977, Kashdan et al., 2009).
Table 9

*Items Eliminated as a Result of EFA*

<table>
<thead>
<tr>
<th>Big Five Inventory (BFI)</th>
<th>Need for Cognition Scale (NCS)</th>
<th>Curiosity and Exploration Inventory (CEI-II)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I see myself as someone who has an assertive personality (extraversion).</td>
<td>I like tasks that require little thought once I’ve learned them.</td>
<td>I actively seek as much information as I can in new situations (stretching).</td>
</tr>
<tr>
<td>I see myself as someone who is curious about many different things (openness).</td>
<td>I feel relief rather than satisfaction after completing a task that required a lot of mental effort.</td>
<td></td>
</tr>
<tr>
<td>I see myself as someone who is ingenious, a deep thinker (openness).</td>
<td>I prefer to think about small, daily projects to long-term ones.</td>
<td></td>
</tr>
<tr>
<td>I see myself as someone who is helpful and unselfish with others (agreeableness).</td>
<td>I usually end up deliberating about issues even when they do not affect me personally.</td>
<td></td>
</tr>
<tr>
<td>I see myself as someone who likes to cooperate with others (agreeableness).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I see myself as someone who is generally trusting (agreeableness).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I see myself as someone who prefers work that is routine (openness).</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Independent t test.** The Need for Cognition (NCS) resulting scores were divided into two categories using the median ($Mdn = 62.0$) to establish high cognition and low cognition categories. Cohen et al. (1955) theorized the need for cognition as “a need to structure relevant situations in meaningful, integrated ways” (p. 291) and a need to understand the world. The need
for cognition was examined in the current study relative to conscientiousness, openness, and curiosity. Independent *t* tests were performed to assess mean differences between students of high and low cognition on each of the subscales: conscientiousness, openness, and curiosity and exploration. Each subscale is discussed individually.

**Conscientiousness.** The personality trait, conscientiousness, is described as competence, order, achievement striving, and self-discipline (John & Srivastava, 1999). The conscientiousness BFI subscale may be considered a measure of effort (John & Srivastava, 1999; von Stumm & Ackerman, 2013). Previous research (Sadowski & Cogburn, 1997) indicated a positive association (*r* = .40) between need for cognition and conscientiousness. The current study confirmed the previous research with a positive relationship (*r* = .30, *p* < .01) between conscientiousness and need for cognition. The significant, although low, correlation led to the question of differences between students of high and low cognition relative to conscientiousness. The results of the independent *t* test indicated greater levels of conscientiousness in students of high cognition (*M* = 3.97, *SD* = .59) versus students of low cognition (*M* = 3.65, *SD* = .56). This difference, -.32, 95% CI [-.40, -.24], was significant *t*(820) = -7.95, *p* = .001; this represents a large effect, *n*² = .07. These findings support theoretical notions of intellectual development being directed by certain personality traits such as conscientiousness (Ackerman, 1996; Cattell, 1987).

**Openness.** The personality trait, openness, consists of facets of curiosity, imagination, and wide interests (John & Srivastava, 1999). The openness BFI subscale is often positively associated with crystallized intelligence (von Stumm, 2013). Previous research (Kashdan et al., 2004; von Stumm, 2013) indicated a significant association between need for cognition and openness (*r* = .43, *r* = .54, respectively). These findings are consistent with the current study’s
finding of a positive relationship \((r = .54, p < .01)\) between openness and need for cognition. This significant correlation guided an investigation of the differences in students of low versus high cognition relative to openness. The results of the independent \(t\) test indicated greater levels of openness in students of high cognition \((M = 3.92, SD = .51)\) versus students of low cognition \((M = 3.38, SD = .54)\). This difference, \(-.54, 95\%\ CI \([- .61, -.47]\), was significant \(t(820) = -14.75, p = .001;\) this represents a very large effect, \(n^2 = .21\). These results relate to Cattell’s (1987) premise of greater cognitive function’s relationship to personality traits such as openness and conscientiousness.

**Curiosity and exploration.** Curiosity and exploration refers to an individual’s motivation to seek knowledge and embrace new experiences and situations (Kashdan et al., 2009). The current study established a positive relationship \((r = .54, p < .01)\) between curiosity and exploration and the need for cognition. This result is consistent with previous research (Olson, Camp, & Fuller, 1984) indicating positive associations between need for cognition and curiosity \((r = .41)\). The results of the independent \(t\) test indicated greater levels of curiosity and exploration in students of high cognition \((M = 40.96, SD = 5.66)\) versus students of low cognition \((M = 35.07, SD = 6.10)\). This difference, \(-5.89, 95\%\ CI \([- .70, -5.09]\), was significant \(t(820) = -14.31, p = .001;\) this represents a very large effect, \(n^2 = .20\). These results support the theories of Cattell (1987) and Berlyne (1960) that individuals with higher cognitive performance tend to be more curious. The implications for each of these significant outcomes are further addressed in Chapter V.
Conceptual Definition of Intellectual Curiosity

Intellectual curiosity has been previously discussed in related literature (see section from Chapter II) but not operationally defined, Table 10 presents a combination of descriptions identified from the literature to evaluate the concept of intellectual curiosity.

Table 10

*Identification of Intellectual Curiosity in Literature*

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Type of Study/Description of Intellectual Curiosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>von Stumm et al. (2011)</td>
<td>Meta-analysis (N = 11 studies): determinant of academic achievement; associations with intelligence and conscientiousness, persistence, intellectual engagement, and desire to understand the world.</td>
</tr>
<tr>
<td>Russell (2013)</td>
<td>Principle-based concept analysis (N = 47 studies): intellectual curiosity is related to individual motivation and cognitive processes such as thinking, exploration, and knowledge acquisition.</td>
</tr>
<tr>
<td>von Stumm &amp; Ackerman (2013)</td>
<td>Meta-analysis (N = 112 studies): intellectual curiosity identified as a trait cluster of intellectual investment which included epistemic curiosity, academic curiosity, need for cognition, inquiring intellect, understanding, novelty experiencing, and openness to ideas with a “preference for seeking out information” (p. 8). Intellectual curiosity was hypothesized to depend on an individual’s “need to engage with and understand the environment” (p. 7).</td>
</tr>
</tbody>
</table>
Table 10

Identification of Intellectual Curiosity in Literature (continued)

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Type of Study/Description of Intellectual Curiosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grossnickle (2014)</td>
<td>Literature review ($N = 39$ studies): referred to intellectual curiosity as epistemic or information seeking and related to Dewey’s (1910) perspective of the goal of education to stimulate intellectual curiosity. Curiosity is multidimensional with cognitive (thinking/reasoning), affective (heightened arousal/emotions), and behavioral components (exploration/knowledge seeking).</td>
</tr>
<tr>
<td>Kolb, Longest, &amp; Barnett (2014)</td>
<td>Qualitative study with rank ordering domains ($N = 34$): intellectual curiosity consists of three components, (a) contemplating (thinking about/reflecting/exploring new material outside of class); (b) consuming (new information/experiences); and (c) committing (intellectual interaction with others).</td>
</tr>
</tbody>
</table>

Research Question

This study began with the intent of addressing the research question: Will an empirical examination of the interrelationships among the constructs posited by Cattell and Berlyne such as curiosity, thinking, and intellectual engagement provide an empirical definition of intellectual curiosity? Curiosity was measured by the two subscales of the CEI-II: (a) stretching and (b) embracing. Thinking was measured by the NCS. Intellectual engagement was measured by the NCS and the BFI, particularly the openness, conscientiousness, and extraversion subscales. As indicated by the correlation analysis, thinking, curiosity, and intellectual engagement were positively associated with significant relationships determined within the current study among the following variables/subscales: openness, conscientiousness, curiosity and exploration, and need for cognition.
Exploratory factor analysis of all test items across the three instruments indicated consistency of factor commonalities with 47% of the variance explained by eight factors. Good model fit was indicated for the eight-factor model with final interpretation of factor loadings resulting in maintaining seven factors as the two subscales stretching and embracing loaded as one curiosity factor. Test items were also reduced from 72 to 60. Internal consistency for each resulting factor was within an alpha coefficient range of .73 to .89.

A comparison of means between students with low and high need for cognition indicated significant differences on openness, curiosity, conscientiousness, and extraversion. These results suggest students with a high need for cognition are more open to new experiences, are more curious about their environment and have a greater desire for knowledge, tend to put forth more effort with more organization and focus, and tend to be more outgoing and social than students with a low need for cognition.

A conceptual definition of intellectual curiosity was extracted from a review of previous research suggesting consistency of terms such as cognitive/intellectual engagement, seeking new information/knowledge, desiring to engage in and understand the world, thinking/self-reflection, and conscientiousness. These conceptual descriptors for intellectual curiosity align with the current study’s quantitative analyses and hypothetical statement regarding the bridging of Cattell’s theory of intelligence and Berlyne’s theory of curiosity to empirically define intellectual curiosity.

Chapter Summary

Chapter IV included a description of the study’s sample demographics, correlation analyses to determine the nature of the relationships between variables, an exploratory factor analysis to explore the overall joint model of the three measures: Curiosity and Exploration
Inventory-II, the Need for Cognition Scale, and the Big Five Inventory, a description of the model, and psychometric information for the newly generated factor model. The independent $t$ test procedures further explored the differences between students with low and high cognition relative to the following subscales: conscientiousness, openness, and curiosity and exploration. A conceptual definition of intellectual curiosity was explored through a review of recent literature. The chapter culminated in an interpretation of the results relevant to the research question. Chapter V will further explore the implications of the research findings as well as recommendations for future researchers.
CHAPTER V

CONCLUSION

Chapter V offers a conclusion to the research study and begins with a summary of the research. An in depth focus of the research findings follows with a discussion of the limitations of the study, possible implications for theory, practice, and education as well as suggestions for further research.

Summary of Research

The purpose of this study was to identify and establish a definition of intellectual curiosity generated by the strong framework established for the study and empirically driven by examining the interrelationships between curiosity, thinking, and intellectual engagement as defined by Cattell (1943, 1957, 1987) and Berlyne (1954, 1960, 1962). Intellectual curiosity, although discussed in meta-analytic and qualitative studies, has not previously been empirically defined. This study investigated the possibility of using three different instruments representing constructs generated by the theoretical framework and guided by the prior efforts of Cattell (1943, 1957, 1987) and Berlyne (1954, 1960, 1962) to define and measure intellectual curiosity. The three instruments align with the constructs and specific variables of curiosity, thinking, engagement, and personality.

The instruments used in the study were the Curiosity and Exploration Inventory (CEI)-II (Kashdan et al., 2009), the Need for Cognition Scale (NCS; Cacioppo et al., 1984), and the Big Five Inventory (BFI; John et al., 1991). The CEI was used to measure students’ level of curiosity through knowledge seeking behavior. The NCS measured students’ tendency to engage in and enjoy thinking. The BFI measured five dimensions of personality traits: openness, conscientiousness, extraversion, agreeableness, and neuroticism.
The three instruments comprised 72 questions using a Likert type scale. Participants totaled 822 undergraduate students at a university in the southeast region of the United States. Data analysis included correlational and exploratory factor analyses, as well as independent t tests.

The following research question guided the study: Will an empirical examination of the interrelationships among the constructs posited by Cattell, intellectual investment (engagement, openness, conscientiousness, extraversion, agreeableness, and neuroticism), and Berlyne, epistemic curiosity (exploration, thinking, and consultation) provide an empirical definition of intellectual curiosity? Each of the major research findings from Chapter IV will be discussed in relation to the research question.

Discussion of the Findings

The current study’s results from the correlation analyses were consistent with previous research findings of significant, positive relationships among the variables openness (Kashdan et al., 2004; von Stumm, 2013), conscientiousness (Sadowski & Cogburn, 1997), curiosity (Olson et al., 1984), and need for cognition. Although positively associated, results of the collinearity diagnostics indicated no multicollinearity was evident and the variables were determined to be distinct.

The factor analytic findings support the theories of Cattell and Berlyne and also parallel the conceptual definitions of intellectual curiosity from the literature (Cyr, 1996; Grossnickle, 2014; Kolb, Longest, & Barnett, 2014; Russell, 2013; von Stumm & Ackerman, 2013; von Stumm et al., 2011) as intellectual and environmental engagement, knowledge acquisition, curiosity, exploration, conscientiousness, and openness to new ideas and experiences. The exploratory factor analysis reduced the 72 items from three instruments to 60 items with seven factors: Curiosity, Need for cognition, Openness, Conscientiousness, Extraversion,
Agreeableness, and Neuroticism. These seven factors emerging from the current study are discussed relative to the theoretical constructs of Berlyne (1954, 1960) and Cattell (1943, 1957, 1987), previous research efforts, and the aforementioned conceptual definitions from the literature.

**Epistemic curiosity.** Berlyne (1954, 1960) described epistemic curiosity as consisting of thinking, consultation, and exploration; each of the variables plays a role in intellectual development. The most important component of exploration is whether the exploration becomes reinforcing to the individual (Berlyne, 1960). According to Berlyne (1960), the exploratory behavior is reinforcing if a “residue of knowledge” (p. 265) remains after the individual’s engagement in knowledge seeking. Consultation involves an individual’s search for knowledge from other individuals or the reference of books or online materials. An important component of consultation is the social and/or environmental engagement that assists in the knowledge seeking process. Exploration and consultation occur in conjunction with thinking (Berlyne, 1960). If the process of knowledge seeking and attainment is satisfying, this rewarding process is likely to be repeated, thus resulting in intentional learning. Berlyne (1966) found that intelligence and curiosity were contributing characteristics to retention of information.

**Factor 1: Curiosity and exploration.** The current study found significant relationships between curiosity and need for cognition \( (r = .54, p < .01) \) and openness \( (r = .48, p < .01) \). Although all variables were significantly associated with curiosity \( (p < .01) \), only need for cognition and openness exhibited associations \( (r \text{ values}) \) greater than .40. As discussed in Chapter IV, students demonstrating high need for cognition demonstrated significantly greater levels of curiosity and exploration than students demonstrating low need for cognition. This study’s findings regarding curiosity and exploration supports previous research and the
literature’s conceptual definition of intellectual curiosity as increased questioning (Cyr, 1996),
cognitive processes such as thinking and exploration (Grossnickle, 2014; Kolb et al., 2014;
Russell, 2013), epistemic or academic curiosity and novelty experiencing (Kolb, Longest, &
Barnett, 2014; von Stumm & Ackerman, 2013), and heightened arousal/emotions (Grossnickle,
2014).

**Factor 2: Need for cognition.** The Need for Cognition Scale (NCS; Cacioppo et al.,
1984), and the Curiosity and Exploration Inventory (CEI-II; Kashdan et al., 2009) were used to
measure Berlyne’s three variables of epistemic curiosity: thinking, consultation, and exploration.
The results supported the use of the NCS and CEI-II to measure the variables. However, results
of the factor analysis did not support the two different factor loadings of stretching and
embracing as in Kashdan et al.’s (2009) instrument validation study. Items for the CEI-II loaded
on one factor of curiosity and exploration. The Need for Cognition factor was reduced from 18 to
15 items. Curiosity and exploration was significantly associated with need for cognition ($r = .54,$
$p < .01$). Student participants in the current study demonstrating high need for cognition were
found to be more curious than students with low need for cognition. These results suggest study
participants with higher cognitive performance levels tend to be more curious. The results
support previous research findings which suggest the NCS measures not only an individual’s
engagement in and enjoyment of thinking (Cacioppo et al., 1984), but also an individual’s need
to cognitively engage with and understand the world (von Stumm & Ackerman, 2013). Previous
research and the current study’s findings also support Cattell’s (1943) theory of intellectual
investment or engagement being related to certain personality traits.

**Intellectual investment.** Cattell’s (1943) theory of intellectual investment suggested age-
related changes in cognitive performance are influenced by certain personality traits determining
the way mental abilities are applied. Cattell (1987) contended that certain traits predispose an
individual to seek out particular environments and stimulate cognitive routines. Although
originally theorized by Cattell as 16 personality traits, subsequent research (Costa & McCrae,
1990; DeYoung et al., 2007; Goldberg, 1990; McCrae & Costa, 1987, 1992; Tupes & Christal,
1961) has found evidence to support five major factors of personality traits: openness,
conscientiousness, extraversion, agreeableness, and neuroticism. Further research, such as Goff
and Ackerman (1992), suggested the extent to which individuals engage with their environment
may predict typical intellectual performance. The current study utilized the NCS to assess the
extent to which individuals engage their environment intellectually. The Big Five Inventory
(BFI; John, Donahue, & Kentle, 1991) was used to measure the five major dimensions of
personality in relation to curiosity and intellect. Cattell’s (1943, 1957, 1987) theory and previous
research (DeYoung, Quilty, & Peterson, 2007; Goldberg, 1990; John & Srivastava, 1999;
McCrae & Costa, 1987, 1992) have suggested the five personality dimensions indicate an
individual’s proclivity to certain behaviors and activities. The current study utilized
recommendations by NCS developers Cacioppo and Petty (1982) to examine the differences
between individuals with high need for cognition and low need for cognition. The differences in
cognition were examined in relation to each of the variables found to have significant (p < .01),
positive correlations with need for cognition.

**Factor 3: Openness.** Sometimes referred to as intellect or imagination, openness
“describes the breadth, depth, originality, and complexity of an individual’s mental and
experiential life” (John & Srivastava, 1999, p. 30). Openness has also been found to predict
academic performance and reflect an individual’s interest or engagement in intellectual activities,
as well as perceived intelligence (DeYoung, 2011; John & Srivastava, 1999). The current study
found a significant relationship between openness and need for cognition \((r = .54, p < .01)\). As discussed in Chapter IV, students demonstrating high need for cognition were significantly more open than students demonstrating low need for cognition. This study’s finding regarding openness supports previous research and the literature’s conceptual definition of intellectual curiosity as openness to new ideas and experiences, a need to engage with and understand the world, imaginative, and a general sense of curiosity (Cyr, 1996; Grossnickle, 2014; Kolb et al., 2014; Russell, 2013; von Stumm & Ackerman, 2013; von Stumm et al., 2011).

**Factor 4: Conscientiousness.** Conscientiousness is also a predictor of academic performance (Chamorro-Premuzic & Furnham, 2008; Diseth, 2013; Laidra, Pullmann, & Allik, 2007; von Stumm et al., 2011). Competence, order, dutifulness, achievement striving, self-discipline, and deliberation are facets comprising conscientiousness (John & Srivastava, 1999). The current study found a significant association between conscientiousness and need for cognition \((r = .29, p < .01)\). As discussed in Chapter IV, students demonstrating high need for cognition were significantly more conscientious than students demonstrating low need for cognition. The current study’s finding regarding conscientiousness supports the previous research and the literature’s conceptual definition of intellectual curiosity as persistence (Cyr, 1996; von Stumm et al., 2011), self-reflection (Cyr, 1996; Kolb et al., 2014), and competence (Grossnickle, 2014).

**Factor 5: Extraversion.** Social facets such as sociability, activity, adventure seeking, and warmth characterize extraversion (John & Srivastava, 1999). Previous research has found extraversion to be negatively associated with academic performance (Chamorro-Premuzic & Furnham, 2008; Furnham, Nuygards, & Chamorro-Premuzic, 2013; Poropat, 2009). Furnham et al. (2013) suggested extroverted individuals may underperform at the university level because of
their inclination for socializing and distractibility. In addition, previous studies (Nussbaum & Bendixen, 2003; Sadowski & Cogburn 1997) found no significant association between extraversion and need for cognition. Although not a direct academic performance measure, the current study did find a significant, but low correlation ($r = .08, p < .05$) between extraversion and need for cognition. Students demonstrating a high need for cognition also scored higher on the extraversion scale than students with a low need for cognition. This outcome refutes the findings from the literature (Nussbaum & Bendixen, 2003; Sadowski & Cogburn 1997). Previous research related to a conceptual definition of intellectual curiosity includes social elements of how a student interacts with the learning environment (Cyr, 1996; Kolb et al., 2014). However, upon reviewing the individual items within the extraversion scale, the personality dimension extraversion is more reflective of an individual’s purely social nature rather than an individual’s intellectually social nature. Therefore, based on the current study finding, extraversion may not be descriptive of intellectual curiosity.

**Factors 6 and 7: Agreeableness and Neuroticism.** The current study’s findings included factor loadings on the factors of agreeableness and neuroticism. Although agreeableness and neuroticism were not identified as conceptually defining elements of intellectual curiosity in previous literature, Cattell theorized these traits (1957) as dimensions of personality related to intellect. Agreeableness “contrasts a prosocial and communal orientation towards others with antagonism” (John & Srivastava, 1999, p. 30). Neuroticism contrasts emotional stability with negative emotionality (John & Srivastava, 1999) and Cattell (1957) asserted the neuroticism factor distinguished “neurotics from normal” (p. 897). Correlation analyses revealed significant negative correlations between neuroticism and the variables extraversion, agreeableness, conscientiousness, curiosity, and need for cognition, with the exception of openness, which was
not significant ($r = -.00$). These findings support Cattell’s (1945, 1957) theory and previous research (Costa & McCrae 1990, 1992a; John & Srivastava, 1999). The current study also found low, but significant correlations between agreeableness and the variables extraversion, agreeableness, conscientiousness, curiosity, and need for cognition, with the exception of openness, which was not significant ($r = .06$). These findings support theory (Cattell, 1945, 1957) and previous research (DeYoung, 2011; Keyes, Kendler, Myers, & Martin, 2015; McCrae & Costa, 2004). As theorized by Cattell and supported by previous research and the current study, the factors of agreeableness and neuroticism may play an important role in predicting anti-social behavior and internalizing disorders (John & Srivastava, 1999). An assessment of agreeableness and neuroticism may assist in admission and employment decisions in association with other factors to determine the stability and success of applicants (Guion 1987; Hunter & Hunter, 1984; Schmitt, Rogers, Chan, Sheppard, & Jennings, 1997). Due to this consideration as supported by the literature, the agreeableness and neuroticism factors were not eliminated from the current study’s examination and discussion of intellectual curiosity.

**Conceptual Definitions**

Conceptual definitions are commonly derived during the early stages of research from theory and then examined using case study data, literature synthesis, or metasynthesis, (Jabareen, 2009). Kerlinge and Lee (2000) describe concepts as expressing “an abstraction formed by generalization from particulars” (p. 40). Concepts, unlike constructs, lack additional meaning (Kerlinge & Lee, 2000). Kerlinge and Lee further delineate definitions as constitutive or operational. The definition of a construct “using other constructs” (Kerlinge & Lee, 2000, p. 42) is considered constitutive. In contrast, operational definitions “assign meaning to a construct or variable by specifying the activities or ‘operations’ necessary to measure it and evaluate the
measurement” (Kerlinger & Lee, 2000, p. 42). Operational definitions are crucial elements of scientific research because operation definitions (a) control the generality of results obtained (Bordens & Abbott, 1996), (b) are “bridges between the theory-hypothesis-construct level and the level of observation” (Kerlinger & Lee, 2000, p. 43), and (c) enable researchers to replicate research findings and enrich scientific implications (Northrop 1947/1983). Kerlinger and Lee (2000) support the use of hypothesized relationships as indicative of operationally defining a construct. The current study utilized intellectual investment and epistemic curiosity and the hypothesized relationships between these two constructs to operationally or empirically define intellectual curiosity. The alignment of the factor analytic results with the conceptual definitions found in the literature (Cyr, 1996; Grossnickle, 2014; Kolb et al., 2014; Russell, 2013; von Stumm & Ackerman, 2013; von Stumm et al., 2011) support an empirical definition of intellectual curiosity. Current study outcomes, in support of the aforementioned previous literature, suggest a definition of intellectual curiosity encompasses the following:

- intellectual engagement (Cyr, 1996; Kolb, Longest, & Barnett, 2014; von Stumm & Ackerman, 2013; von Stumm et al., 2011);
- seeking new information through curiosity and exploration (Cyr, 1996; Grossnickle, 2014; Kolb et al., 2014; Russell, 2013; von Stumm & Ackerman, 2013; von Stumm et al., 2011);
- the desire to engage in and understand the world (Cyr, 1996; Kolb et al., 2014; von Stumm & Ackerman, 2013; von Stumm et al., 2011);
- conscientiousness (Cyr, 1996; Grossnickle, 2014; Kolb, Longest, & Barnett, 2014; von Stumm et al., 2011); and
openness to new ideas and experiences (Cyr, 1996; Grossnickle, 2014; Kolb et al., 2014; Russell, 2013; von Stumm & Ackerman, 2013; von Stumm et al., 2011).

Limitations of the Study

Certain limitations are often associated with research and these limitations may affect the interpretation of the results and the extent to which the results can be generalized. The limitation with potential impact on the current study’s findings is sampling.

Sampling. The current study’s sample of participants was representative of the undergraduate population of the university from which the sample was drawn. Because the current study’s sample was one of convenience and was limited to a single institution, the results cannot guarantee representativeness of the greater population of university undergraduate students. According to the National Center for Education Statistics (Snyder & Dillow, 2015), the male-female ratio of public university students is 43:57% which is consistent with the current study’s findings. In addition, 88% of undergraduate students enrolled nationally are under the age of 25 (Snyder & Dillow, 2015). This statistic is also consistent with the current study’s sample characteristic of 84.2% of undergraduate students age 18-24. Although the current study’s sample of 822 participants represents 8.2% of the selected university’s undergraduate enrollment, the nature of the sample selection (convenience sampling) did not ensure a diverse selection of university students representative of the university’s enrollment.

Implications of the Study

The current study’s findings offer implications for the field of research, practice, and education. Each of the implications will be discussed.

Research. An empirical definition of intellectual curiosity substantiates the previously documented conceptual definitions of intellectual curiosity (Cyr, 1996; Grossnickle, 2014; Kolb,
The current study findings substantiating empirical support for defining intellectual curiosity assists researchers in moving forward to further develop a theory that encompasses intellect and curiosity with the possibility of developing improved, succinct measures of intellectual curiosity for classroom and research purposes. Traditional classroom assessments measure course achievement, the next step in assessment may be to directly measure students’ intellectual curiosity pre and post curriculum delivery (Maki, 2009). The definition also opens the door for investigation for further understanding intellectual curiosity’s internal structure and predictive nature in school and job performance. Additionally, the current study findings focused on empirically defining intellectual curiosity provide evidence for the further development of a framework for intellect as suggested by Mussel (2013).

**Practice.** An empirical definition of intellectual curiosity assists administrators and employers with seeking students and employees that are likely to be successful in life and contribute to global society. With the increasingly competitive nature of specialized undergraduate and graduate programs, additional assessments such as intellectual curiosity may provide admissions counselors with a more complete composite of a student beyond GPA and standardized test scores (Rigol, 2003). A definition of intellectual curiosity may also assist educators with identifying student characteristics that demonstrate intellectual curiosity and may provide a research-based decision regarding a student’s drive to be successful in a program of higher education.

In addition, an empirically based definition of intellectual curiosity allows employers to seek employees who will best support their business structure and desire for success. Previous studies have found the use of personality measures to predict job performance (Barrick, Mount,
& Judge, 2001; Ones, Dilchert, Viswesvaran, & Judge, 2007). An assessment, which incorporates curiosity as well as personality, may more accurately predict job performance thus improving the recruitment and selection process (Mussel, 2013). Furthermore, employment seekers may benefit from the definition of intellectual curiosity in an effort to align their skills and abilities to employment requirements.

**Education.** An empirical definition of intellectual curiosity may assist education for both instructors and students. Professional development workshops at the university and professional association levels may address the need to stimulate intellectual curiosity within faculty and perhaps greater impact teaching practices with the long-term goal of enriching students’ learning. Intellectually curious faculty may be more likely to model and encourage the same in students.

As our technological society continues to progress, education and work have moved beyond the local or national level to global society. Social media and technology pervasive learning modalities have become commonplace. Growing distance learning and technological environments require increasingly important educational environments for stimulating and sustaining students’ intellectual curiosity. An empirical understanding of intellectual curiosity may also assist educators with incorporating the construct into the curriculum and creating a method of measuring intellectual curiosity outcomes within specific courses.

**Future Research**

A true test of theory and research is replication and as the renowned empiricist, Ronald Fisher (1955) declared “we have the duty of formulating, of summarizing, and of communicating our conclusions, in intelligible form, in recognition of the right of other free minds to utilize them in making their own decisions" (p. 77). Suggestions for future research are based on the outcomes of the exploratory factor analysis performed in the current study. The resulting 60
items measure seven factors and may or may not encompass intellectual curiosity. Using a confirmatory factor analysis with a new sample of data will test the factorial validity of the group of test items. As previously stated, the factors of extraversion, agreeableness, and neuroticism, although helpful for determining future success, suggest indirect support for a definition of intellectual curiosity. Further examination of curiosity and exploration, need for cognition, as well as the personality factors of openness, conscientiousness, extraversion, agreeableness, and neuroticism using structural equation modeling may support the direct, indirect, or mediating effects of the variables for intellectual curiosity.

Replication studies with other groups such as vocational school or two-year college students or non-student populations will assist in developing a more generalized definition of intellectual curiosity. Other instruments may also be considered in an effort to narrow focus and determine the discriminant validity of intellectual curiosity. Constructs such as individual self-efficacy or motivation may influence curiosity levels. Therefore, consideration of these additional variables within the context of intellectual curiosity is recommended further research.

Future research might also explore the individual perspectives of faculty and students on the meaning of intellectual curiosity. This type of personal approach to an investigation may assist in clarifying or confirming the definition of intellectual curiosity and assist in curriculum inclusion. In addition, methods for engaging students’ intellectual curiosities and sustaining students’ engagement levels are pertinent to explore for expanding research efforts focused on the improved quality of online and face-to-face educational programs.

Cattell (1943) suggested cognitive performance is influenced by certain characteristics or personality traits which determine the way mental abilities are applied. Depending on the performance measure, ability traits can reflect fluid and/or crystallized intelligence (Cattell,
In the current study, the Need for Cognition Scale (NCS) was used as an assessment of students’ desire to engage in and enjoy thinking. The Big Five Inventory (BFI) assessed certain traits associated with ability, but neither of these assessments directly measure ability or cognitive performance. Although high scores on the NCS and BFI have previously been associated with high scores on tests of cognitive ability, the current study does not suggest a causal relationship between a high need for cognition and higher grade point average or greater cognitive ability. Scores on the BFI, such as a high score on the Openness to Experience scale or Conscientiousness scale, are positively associated with an individual’s general intelligence (von Stumm, Hell, & Chamorro-Premuzic, 2011; Poropat, 2009). One final suggestion for further research is to examine the relationship between a direct measure of academic performance with the intellectual curiosity measure. A 2014 study by Powell and Nettelbeck also supported the notion of investigating intellectual curiosity in conjunction with academic performance measures. Possible measure considerations may be actual GPA or a more complex measure of fluid intelligence such as Raven's progressive matrices.

Chapter Summary

The goal of this study was to empirically define intellectual curiosity as guided by the theories of Cattell and Berlyne. This chapter summarizes the study and offers a discussion of the findings related to theory and previous research. Limitations of the study are presented as well as implications of the findings for research practice and education. Finally, recommendations for future research are presented. The results of this study indicate that Cattell’s (1943, 1957) theory of intellectual investment and Berlyne’s (1954, 1960) theory of curiosity can be integrated to formulate an empirical definition for intellectual curiosity. This study proposes an empirical definition of intellectual curiosity as encompassing intellectual engagement, seeking new
information through curiosity and exploration, the desire to engage in and understand the world, conscientiousness, and openness to new ideas and experiences.
REFERENCES


Retrieved from https://www2.ed.gov/pubs/Toolbox/index.html


108

doi:10.1037/0022-0663.84.4.537

doi:10.1037/0022-3514.59.6.1216


doi:10.1007/s10648-014-9294-y


doi:10.1016/j.paid.2010.05.014


doi:10.1037/a0031918


*Proceedings of Selected Research and Development Presentations at the 1994 National Convention of the Association for Educational Communications and Technology Sponsored by the Research and Theory Division* (16th, Nashville, TN, February 16-20, 1994). Retrieved ERIC database. (ED373755)


APPENDICES
Appendix A

Survey and Informed Consent
INFORMED CONSENT FORM

Principal Investigator: Nancy Bridier, Doctoral Candidate, University of West Florida
Contact Information: Phone: [redacted] Email: nlb4@students.uwf.edu
Dissertation Committee Chair: Dr. Carla Thompson (cthompson1@uwf.edu)

Purpose and Benefits

The research project in which you are being asked to participate is for the fulfillment of dissertation at The University of West Florida. The purpose of the study is to define and measure intellectual curiosity among university students, by assessing their interest in thinking, learning, and self-perceptions. Although there are no direct benefits to study participation, you are assisting in furthering research efforts in higher education.

Procedures

If you agree to participate, you will be asked to complete a survey to evaluate your self-perception and your interests. The time required to complete the survey is approximately 15 minutes. There are no correct or incorrect responses and no identifying information will be attached to your participation in this research effort.

Risk, Stress, Discomfort

There are minimal risks to participants associated with participation in this study. These risks are associated with you being asked to consider your personal feelings and interests. While participating in this study, if you experience any distress, you may discontinue the survey at any time. Refusal to participate or continue participation, once begun, will not result in any negative consequences.

Other Information

Your responses and information in the study will be retained by the co-investigators, entered into a password protected computer file, and will only be identified by an assigned number. Only the co-investigators will have access to the data file and will keep this information anonymous, which means that your information will not be identified as individual data in any way. Data from the surveys will not be distributed in any manner that can be linked to your responses.

Your signature below will indicate that you have understood what is being asked of you, that you have understood all participation is voluntary, that you have the right to discontinue participation in this study at any time, there are no direct benefits or losses to you for participation, and that you are over the age of 18.

Year of birth (to verify I am over the age of 18): ______________

__________________________________________  _________________________
Signature                                      Date
Please Complete the Following Demographic Questions

1. Gender you identify as: ______ Male ______ Female

2. Age: ______

3. What is your current classification?
   ______ Freshman
   ______ Sophomore
   ______ Junior
   ______ Senior
   ______ Undetermined

4. What is your Academic Major?

          ___________________________
How I am in general

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who \textit{likes to spend time with others}? Please write a number next to each statement to indicate the extent to which \textbf{you agree or disagree with that statement}. 

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disagree Strongly</td>
<td>Disagree a little</td>
<td>Neither agree nor disagree</td>
<td>Agree a little</td>
<td>Agree strongly</td>
</tr>
</tbody>
</table>

I see Myself as someone who...

1. _____ Is talkative  
2. _____ Tends to find fault with others  
3. _____ Does a thorough job  
4. _____ Is depressed, blue  
5. _____ Is original, comes up with new ideas  
6. _____ Is reserved  
7. _____ Is helpful and unselfish with others  
8. _____ Can be somewhat careless  
9. _____ Is relaxed, handles stress well.  
10. _____ Is curious about many different things  
11. _____ Is full of energy  
12. _____ Starts quarrels with others  
13. _____ Is a reliable worker  
14. _____ Can be tense  
15. _____ Is ingenious, a deep thinker  
16. _____ Generates a lot of enthusiasm  
17. _____ Has a forgiving nature  
18. _____ Tends to be disorganized  
19. _____ Worries a lot  
20. _____ Has an active imagination  
21. _____ Tends to be quiet  
22. _____ Is generally trusting  
23. _____ Tends to be lazy  
24. _____ Is emotionally stable, not easily upset  
25. _____ Is inventive  
26. _____ Has an assertive personality  
27. _____ Can be cold and aloof  
28. _____ Perseveres until the task is finished  
29. _____ Can be moody  
30. _____ Values artistic, aesthetic experiences  
31. _____ Is sometimes shy, inhibited  
32. _____ Is considerate and kind to almost everyone  
33. _____ Does things efficiently  
34. _____ Remains calm in tense situations  
35. _____ Prefers work that is routine  
36. _____ Is outgoing, sociable  
37. _____ Is sometimes rude to others  
38. _____ Makes plans and follows through with them  
39. _____ Gets nervous easily  
40. _____ Likes to reflect, play with ideas  
41. _____ Has few artistic interests  
42. _____ Likes to cooperate with others  
43. _____ Is easily distracted  
44. _____ Is sophisticated in art, music, or literature
**Instructions:** Please indicate your level of agreement to each of the following statements as follows:

<table>
<thead>
<tr>
<th></th>
<th>Disagree Strongly</th>
<th>Disagree a little</th>
<th>Neither agree nor disagree</th>
<th>Agree a little</th>
<th>Agree strongly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I would prefer complex to simple problems.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>I like to have the responsibility of handling a situation that requires a lot of thinking.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Thinking is not my idea of fun.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>I find satisfaction in deliberating hard and for long hours.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>I only think as hard as I have to.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>I prefer to think about small, daily projects to long-term ones.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>I like tasks that require little thought once I’ve learned them.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>The idea of relying on thought to make my way to the top appeals to me.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>I really enjoy a task that involves coming up with new solutions to problems.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Learning new ways to think doesn’t excite me very much.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>I prefer my life to be filled with puzzles that I must solve.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>The notion of thinking abstractly is appealing to me.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>I feel relief rather than satisfaction after completing a task that required a lot of mental effort.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>It’s enough for me that something gets the job done; I don’t care how or why it works.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>I usually end up deliberating about issues even when they do not affect me personally.</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Instructions:** Rate the statements below for how accurately they reflect the way you generally feel and behave. Do not rate what you think you should do, or wish you do, or things you no longer do. Please be as honest as possible.

<table>
<thead>
<tr>
<th></th>
<th>1 Disagree Strongly</th>
<th>2 Disagree a little</th>
<th>3 Neither agree nor disagree</th>
<th>4 Agree a little</th>
<th>5 Agree strongly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I actively seek as much information as I can in new situations.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>2</td>
<td>I am the type of person who really enjoys the uncertainty of everyday life.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>3</td>
<td>I am at my best when doing something that is complex or challenging.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>4</td>
<td>Everywhere I go, I am out looking for new things or experiences.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>5</td>
<td>I view challenging situations as an opportunity to grow and learn.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>6</td>
<td>I like to do things that are a little frightening.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>7</td>
<td>I am always looking for experiences that challenge how I think about myself and the world.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>8</td>
<td>I prefer jobs that are excitingly unpredictable.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>9</td>
<td>I frequently seek out opportunities to challenge myself and grow as a person.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>10</td>
<td>I am the kind of person who embraces unfamiliar people, events, and places.</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>
Appendix B

Institutional Review Board Approval Letter
Ms. Nancy Bridier  
Bldg. 86, Room 112  

Dear Ms. Bridier:  

The Institutional Review Board (IRB) for Human Research Participants Protection has completed its review of your proposal number IRB 2016-030 titled, "Defining and Measuring Intellectual Curiosity in Higher Education," as it relates to the protection of human participants used in research, and granted approval for you to proceed with your study on 09-14-2015. As a research investigator, please be aware of the following:

* You will immediately report to the IRB any injuries or other unanticipated problems involving risks to human participants.

* You acknowledge and accept your responsibility for protecting the rights and welfare of human research participants and for complying with all parts of 45 CFR Part 46, the UWF IRB Policy and Procedures, and the decisions of the IRB. You may view these documents on the Research and Sponsored Programs web page at [http://research.uwf.edu](http://research.uwf.edu). You acknowledge completion of the IRB ethical training requirements for researchers as attested in the IRB application.

* You will ensure that legally effective informed consent is obtained and documented. If written consent is required, the consent form must be signed by the participant or the participant's legally authorized representative. A copy is to be given to the person signing the form and a copy kept for your file.

* You will promptly report any proposed changes in previously approved human participant research activities to Research and Sponsored Programs. The proposed changes will not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the participants.

* You are responsible for reporting progress of approved research to Research and Sponsored Programs at the end of the project period 03-15-2016. If the data phase of your project continues beyond the approved end date, you must receive an extension approval from the IRB.

Good luck in your research endeavors. If you have any questions or need assistance, please contact Research and Sponsored Programs at 850-875-6378 or irb@uwf.edu.

Sincerely,

Dr. Rick Harper, Ph.D., Associate Vice President for Research and Economic Opportunity  

Dr. Ludmila Cosin-Lima, Chair, IRB for Human Research Participant Protection  

CC: Jennifer Whatley
Appendix C

Letter of Permission to use Curiosity and Exploration Inventory (CEI-II)
Permission to use the Curiosity and Exploration Inventory

On Aug 15, 2015, at 4:18 PM, Nancy Bridier <nlb4@students.uwf.edu> wrote:

I'm completing my dissertation at the University of West Florida and would like to request your permission to use the CEI-II for data collection. Although the instrument is available on your website, I wanted to formally request permission. I will of course reference the source as well as the validation information. I am planning to use approximately 400 undergraduate students and I'd be happy to share my results with you.

Thank you for your consideration,

Nancy Bridier

Todd Kashdan <kashdan@gmail.com> 8/15/15

to Nancy Bridier <nlb4@students.uwf.edu>

Of course. And keep me posted

Sent from my iPhone
Appendix D

Letter of Permission to use Need for Cognition Scale (NCS)
Permission to use the Need for Cognition Scale

Nancy Bridier <nb4@students.uwf.edu> 8/15/15

to John T. Cacioppo <jacaciopp@uchicago.edu>

Dr. Cacioppo,

I’m completing my dissertation at the University of West Florida and would like to request your permission to use the Need for Cognition Scale for data collection. I will of course reference the source as well as the validation information. I am planning to use approximately 400 undergraduate students and I’d be happy to share my results with you.

Thank you for your consideration,

John T. Cacioppo <jacaciopp@uchicago.edu> 8/17/15

to Nancy Bridier <nb4@students.uwf.edu>

Nancy,

The use of the need for cognition scale is free as long as it is for research purposes. We would love to hear what you find when you complete the project.

Thank you,

John
Appendix E

Letter of Permission to use Big Five Inventory (BFI)
Permission to use the BFI and adapt Tables

Nancy Bridier <nlb4@students.uwf.edu> 8/31/15

to Sanjay Srivastava <sanjay@uoregon.edu>

Dr. Srivastava,

I’m completing my dissertation at the University of West Florida and would like to use the BFI. I’ve read the information regarding permission to use it and I’ve completed the survey on the https://www.ocf.berkeley.edu/~johalab/bfi.php website. Although the website states the BFI can be used without permission, my dissertation adviser requested that I contact you for permission to use the inventory. In an effort to describe the convergent validity information for use in my methodology chapter, I have consolidated the information in Tables three and four of the 1999 "Handbook of personality" chapter 4 and would like to request permission to use this in my dissertation as well. The adapted table is below.

Thank you for your consideration,

Nancy Bridier

<table>
<thead>
<tr>
<th>Measure</th>
<th>Extraversion</th>
<th>Agreeableness</th>
<th>Conscientiousness</th>
<th>Neuroticism</th>
<th>Openness</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFI-TDA</td>
<td>.90</td>
<td>.78</td>
<td>.81</td>
<td>.76</td>
<td>.75</td>
<td>.81</td>
</tr>
<tr>
<td>BFI-NEO</td>
<td>.83</td>
<td>.97</td>
<td>.96</td>
<td>.90</td>
<td>.85</td>
<td>.92</td>
</tr>
<tr>
<td>Mean</td>
<td>.93</td>
<td>.92</td>
<td>.94</td>
<td>.88</td>
<td>.83</td>
<td>.91</td>
</tr>
<tr>
<td>BFI</td>
<td>.94</td>
<td>.92</td>
<td>.92</td>
<td>.90</td>
<td>.92</td>
<td>.92</td>
</tr>
<tr>
<td>TDA</td>
<td>.95</td>
<td>.85</td>
<td>.87</td>
<td>.83</td>
<td>.79</td>
<td>.87</td>
</tr>
<tr>
<td>NEO</td>
<td>.68</td>
<td>.83</td>
<td>.86</td>
<td>.84</td>
<td>.70</td>
<td>.79</td>
</tr>
<tr>
<td>Mean</td>
<td>.90</td>
<td>.87</td>
<td>.89</td>
<td>.86</td>
<td>.83</td>
<td>.87</td>
</tr>
</tbody>
</table>

CFA for BFI Model Fit $\chi^2 = 274 (63); CFI = .958, dF = 22 (p < .05)$


Sanjay Srivastava <sanjay@uoregon.edu> 8/31/15

to Nancy Bridier nlb4@students.uwf.edu

Yes!

Sent from my iPhone
Appendix F

Curiosity and Exploration Inventory (CEI-II)
Curiosity and Exploration Inventory (CEI-II)

Instructions: Rate the statements below for how accurately they reflect the way you generally feel and behave. Do not rate what you think you should do, or wish you do, or things you no longer do. Please be as honest as possible.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I actively seek as much information as I can in new situations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I am the type of person who really enjoys the uncertainty of everyday life.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I am at my best when doing something that is complex or challenging.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Everywhere I go, I am out looking for new things or experiences.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I view challenging situations as an opportunity to grow and learn.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I like to do things that are a little frightening.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I am always looking for experiences that challenge how I think about myself and the world.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I prefer jobs that are excitingly unpredictable.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. I frequently seek out opportunities to challenge myself and grow as a person.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. I am the kind of person who embraces unfamiliar people, events, and places.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stretching: 1,3,5,7 / Embracing: 2,4,6,8,10.

Appendix G

Need for Cognition Scale (NCS)
Need for Cognition Scale (from Cacioppo, Petty, & Kao, 1984)

For each of the statements below, please indicate whether or not the statement is characteristic of you or of what you believe. For example, if the statement is extremely uncharacteristic of you or of what you believe about yourself (not at all like you) please place a “1” on the line to the left of the statement. If the statement is extremely characteristic of you or of what you believe about yourself (very much like you) please place a “5” on the line to the left of the statement. You should use the following scale as you rate each of the statements below.

<table>
<thead>
<tr>
<th>1 extremely uncharacteristic of me</th>
<th>2 somewhat uncharacteristic of me</th>
<th>3 uncertain</th>
<th>4 somewhat characteristic of me</th>
<th>5 extremely characteristic of me</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. _____ I prefer complex to simple problems.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. _____ I like to have the responsibility of handling a situation that requires a lot of thinking.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. _____ Thinking is not my idea of fun.**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. _____ I would rather do something that requires little thought than something that is sure to challenge my thinking abilities.**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. _____ I try to anticipate and avoid situations where there is a likely chance I will have to think in depth about something.**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. _____ I find satisfaction in deliberating hard and for long hours.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. _____ I only think as hard as I have to.**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. _____ I prefer to think about small daily projects to long term ones.**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. _____ I like tasks that require little thought once I’ve learned them.**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. _____ The idea of relying on thought to make my way to the top appeals to me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. _____ I really enjoy a task that involves coming up with new solutions to problems.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. _____ Learning new ways to think doesn’t excite me very much.**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. _____ I prefer my life to be filled with puzzles I must solve.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. _____ The notion of thinking abstractly is appealing to me.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. _____ I would prefer a task that is intellectual, difficult, and important to one that is somewhat important but does not require much thought.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. _____ I feel relief rather than satisfaction after completing a task that requires a lot of mental effort.**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. _____ It’s enough for me that something gets the job done; I don’t care how or why it works.**</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. _____ I usually end up deliberating about issues even when they do not affect me personally.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: **=reverse scored item.
Appendix H

Big Five Inventory (BFI)
# How I am in general

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who **likes to spend time with others**? Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement.

<table>
<thead>
<tr>
<th></th>
<th>1 Disagree Strongly</th>
<th>2 Disagree a little</th>
<th>3 Neither agree nor disagree</th>
<th>4 Agree a little</th>
<th>5 Agree strongly</th>
</tr>
</thead>
</table>

**I am someone who...**

1. ____ Is talkative
2. ____ Tends to find fault with others
3. ____ Does a thorough job
4. ____ Is depressed, blue
5. ____ Is original, comes up with new ideas
6. ____ Is reserved
7. ____ Is helpful and unselfish with others
8. ____ Can be somewhat careless
9. ____ Is relaxed, handles stress well.
10. ____ Is curious about many different things
11. ____ Is full of energy
12. ____ Starts quarrels with others
13. ____ Is a reliable worker
14. ____ Can be tense
15. ____ Is ingenious, a deep thinker
16. ____ Generates a lot of enthusiasm
17. ____ Has a forgiving nature
18. ____ Tends to be disorganized
19. ____ Worries a lot
20. ____ Has an active imagination
21. ____ Tends to be quiet
22. ____ Is generally trusting
23. ____ Tends to be lazy
24. ____ Is emotionally stable, not easily upset
25. ____ Is inventive
26. ____ Has an assertive personality
27. ____ Can be cold and aloof
28. ____ Perseveres until the task is finished
29. ____ Can be moody
30. ____ Values artistic, aesthetic experiences
31. ____ Is sometimes shy, inhibited
32. ____ Is considerate and kind to almost everyone
33. ____ Does things efficiently
34. ____ Remains calm in tense situations
35. ____ Prefers work that is routine
36. ____ Is outgoing, sociable
37. ____ Is sometimes rude to others
38. ____ Makes plans and follows through with them
39. ____ Gets nervous easily
40. ____ Likes to reflect, play with ideas
41. ____ Has few artistic interests
42. ____ Likes to cooperate with others
43. ____ Is easily distracted
44. ____ Is sophisticated in art, music, or literature