Factors Affecting Talent Development: Differences in Graduate Students Across Domains

Stephanie Hartzell
University of Nevada, Las Vegas, stephaniehartzell@hotmail.com

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FACTORS AFFECTING TALENT DEVELOPMENT: DIFFERENCES IN
GRADUATE STUDENTS ACROSS DOMAINS

By

Stephanie Allyssa Hartzell

A dissertation submitted in partial fulfillment
of the requirements for the

Doctor of Philosophy in Educational Psychology

Department of Educational Research, Cognition, & Development

College of Education

The Graduate College

University of Nevada, Las Vegas

May 2012
THE GRADUATE COLLEGE

We recommend the dissertation prepared under our supervision by

Stephanie Allyssa Hartzell

entitled

Factors Affecting Talent Development: Differences in Graduate Students Across Domains

be accepted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in Educational Psychology
Department of Educational Research, Cognition, and Development

Eunsook Hong, Committee Chair
Michael Nussbaum, Committee Member
Carol Anne Kardash, Committee Member
Linda Quinn, Graduate College Representative
Ronald Smith, Ph. D., Vice President for Research and Graduate Studies and Dean of the Graduate College

May 2012
Abstract

There is an abundance of literature on young individuals who show early signs of talent and on older individuals who have demonstrated their abilities throughout the years. This research aims to look at those individuals who are in between, that is, graduate students who have the demonstrated potential to achieve within their fields of study. This study explored backgrounds of talented individuals in their adolescent period and their current measures of cognitive abilities. A total of 38 graduate students majoring in the areas of art ($n = 12$), science ($n = 12$), and education ($n = 14$) were used as examples of individuals who displayed at least a minimal level of talent. Several indicators from three higher order factors that may impact talent development were investigated: cognitive ability (analytical-thinking and creative-thinking abilities), personal-psychological attributes (goal orientation, effort, intrinsic and extrinsic motivation, interest, and self-efficacy), and social-environmental factors (school, family, and social environments). Both quantitative and qualitative data were collected to capture students’ background and experiences. Analytical-thinking ability, verbal creative-thinking ability, motivational attributes, and environmental factors all demonstrated differences among at least two of the three groups, suggesting that gifted individuals from the three domains have varied cognitive abilities and that they perceived themselves having different levels of motivation and/or different levels and types of experiences during their adolescence, although there were similarities on some aspects. These variations across groups indicate that there may be differential developmental trajectories among individuals talented or potentially talented in different domains. Correlation coefficients between analytical-thinking abilities and both verbal and non-verbal creative-
thinking abilities were small, with an exception of the science majors, who demonstrated moderately large relationships between analytical-thinking and creative-thinking abilities. The pattern indicates that creative-thinking ability is not dependent upon analytical-thinking ability or vice versa and that evaluating potentially talented students only on their analytical abilities (i.e., IQ), will likely exclude some creatively talented individuals. However, the positive relationship in science majors suggests that analytical abilities may be an essential component for successful creative work in the scientific fields.

Motivation subcomponents varied within and across majors. For example, although science majors scored higher on extrinsic motivation, education majors tended to be the most highly motivated group in the areas of performance goals, effort, and intrinsic motivation. Differences were also found among the groups on the subcomponents of verbal creative-thinking ability and adolescent activities. The various differences found in this study indicate that differentiated supports may be beneficial for talent development of individuals interested in different domains. It is important to further explore how talented students, with different domains of interest, can be best supported in the development of their talent.
Acknowledgements

I would like to extend a huge THANK YOU to all of the people who supported me on this endeavor:

Dr. Hong, your tireless dedication and pursuit of quality is inspiring and appreciated. Thank you for all of your time, effort, and edits.

Dr. Nussbaum, Dr. Kardash, & Dr. Quinn, thank you for your effort and guidance. It is very much appreciated.

Steve, thank you for everything. I know you didn’t know what we were getting into when this journey started, but it was your love and understanding that kept me going. I love you.

Vander and Von, thank you for having understanding well beyond your years. Let’s have some fun instead of Mom doing homework all of the time.

Mom, thank you for the transcribing, the childcare, and always believing in me.

Dad, thanks for always telling me you were proud of me, even for the little things.
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CHAPTER 1

Introduction

As potential future leaders and innovators of our country, talented students are a valuable natural resource to our country (Winner, 2000). As early as 1971, Marland, then the U.S. Commissioner of Education, addressed Congress to advise them of the trend of students with gifted potential failing to attain gifted status after graduation. In order for teachers and parents to nurture students with potential talents, it is important to identify factors that play significant roles in realizing their potentials.

A number of theoretical conceptualizations and models describe the process of talent development (Gagné, 2007; Noble, Subotnik, & Arnold, 1999). For the current study, the model proposed by Hong and Milgram (2008a), *A Comprehensive Model of Giftedness and Talent*, is employed because it describes the major factors that shape the development of talent: cognitive ability, personal-psychological attributes, and environmental-social factors. These factors are described in the following section as they apply to the current research.

Researchers of creativity, giftedness, and talent have studied talented individuals in order to explore the meaning of talent, the development of talent, and how talent affects their life outcomes (Csikszentmihalyi, 1996; Sternberg, 1995; Terman, 1925; Torrance, 1974). Although various conceptualizations of talent abound, the general consensus is that the level of talent demonstrated by an individual is influenced by factors that are internal to the person, such as innate ability and personality, and external factors,
such as societal pressures (Dai & Renzulli, 2008; Gagné, 2004; Hong & Milgram, 2008a; Perleth & Heller, 1994; Piirto, 1995; Sternberg, 1995).

Most studies exploring talent have dealt with one of two populations. The first group of studies examined accomplished professionals, who have successfully demonstrated their prowess (Csikszentmihalyi, 1996; Gruber & Wallace, 2001; Hébert, Pagnani, & Hammond, 2009; Piirto, 1998; Simonton, 1999a). The second set of research studied children or adolescents who demonstrated high levels of potential talent (Achter, Lubinski, & Benbow, 1996; Achter, Lubinski, Benbow, & Eftekharisanjani, 1999; Emmett & Minor, 1993; Hong, Milgram, & Whiston, 1993; Milgram & Hong, 1999; Piirto, 2005; Rostan, Pariser, & Gruber, 2002; Shilling, Sparfeldt, & Rost, 2006; Trusty & Ng, 2000). However, extensive studies on graduate-level individuals who are actively developing their talent and expertise seem to be sparse. Studies that did examine graduate students as participants include Lubinski, Benbow, Webb, and Bleske-Reebek (2006). They used math and science graduate students as a foil against which people, identified as being gifted at an early age, are measured on creative, vocational, and life accomplishments. Reis (1995) interviewed female graduate students from an Education Department, exploring their perceptions on how their talent development and career choice had been affected by marriage and family constraints.

Another aspect of studies on talented individuals or individuals with potential talents lies in the domains in which individuals' talents manifest. Whether talented individuals from different areas have similar or distinct personal and environmental backgrounds has not been the focus of research, as most studies are completed with individuals who demonstrate talents in one area, for example, science (Areepattamannil,
Freeman, & Klinger, 2011; Subotnik & Steiner, 1994) or music (Davidson & Scripp, 1994; Scripp & Davidson, 1994). Those studies that do look across talent domains are often focused on a single construct, such as extra-curricular interest (Ainley, Hidi, & Bernorff, 2002; Hong et al., 1993; Milgram, Hong, Shavit, & Peled, 1997), creative productivity (Livne and Milgram, 2006; Torrance, 2004), or career decision making (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Emmett & Minor, 1993). That is, a substantial amount of information about how various factors affect the development of talent differently across domains has not been produced.

Although some consider gifted individuals as being multipotential, or talented in multiple areas (Sajjadi, Rejskind, & Shore, 2001), there is no strong evidence that individuals are gifted in multiple areas (Achter, Benbow, & Lubinski, 1997; Milgram & Hong, 1999; VanTassel-Baska, 2005). Multipotentiality is often discussed in the literature focused on career choice for gifted individuals (Kerr & Ghist-Priebe, 1988; Rysiew, Shore, & Leeb, 1999; Sajjadi et al., 2001). They describe gifted individuals who may have a difficult time deciding on a career, because they have interests and capabilities in several fields. Achter et al. (1997) and Milgram and Hong (1999) found in their empirical research that individuals with potential talents are characterized more as unipotential than multipotential. That is, talents are usually developed in a single field, although there are exceptions. These findings suggest that the development of talent in a specific domain is affected by individuals’ personality, interests, and experience that might have led them to a specific talent domain, instead of multiple domains.

Regardless of the specific field a particular individual is interested and has strong potential in, their talent development is affected by various personal and life factors.
However, the ways these factors influence individuals' talent development can vary widely. In the section that follows, the conceptual framework on which this study is based is reviewed.

**Conceptual Framework**

The *Comprehensive Model of Giftedness and Talent* (Hong & Milgram, 2008a) and other literature of giftedness and talent, especially sources that illustrate causal influences on talent development, were used to build a conceptual framework for this study. In the process of reviewing various theories and empirical studies of giftedness and talent, attention was given to factors that contribute to the development of talents.

Gagné (2004) defined talent as “outstanding systematically developed skills which define expertise” (p.119). Gagné’s view, which does not limit talent to academically defined areas, includes the potential for greatness, but also a requirement of skill development. The development of talent, therefore, is not only influenced by factors such as intelligence, but also motivation, creative ability, persistence, and environment (Csikszentmihalyi, 1996; Gagné, 2007; Hong & Milgram, 2008a; Simonton, 1999b; Zimmerman, 1989).

According to Hong and Milgram (2008a), talent development is affected by three primary influencers, cognitive abilities, personal-psychological attributes, and environmental-social factors. Talent is divided into two different but related types, expert and creative. Expert talent is represented by the ability to perform at an expert level or the acquisition of a knowledge base that would qualify one as an expert. Creative talent is characterized by the ability to generate new and unique solutions to problems in a domain. Depending on the tendency and strengths of analytical- or creative-thinking
ability, one may develop stronger talent in one type of talent (e.g., creative) than the other (e.g., analytical) and at a varied “level of talent.” As indicated, talent development of both types is affected by the three major factors. Again, depending on the varied strengths of these factors, direction and strength of an individual’s talent development would be determined.

Although all talent development is affected by individual attributes and external factors, it can take many different forms. From a scientist developing new chemical structures, to an artist creating a musical masterpiece, to a teacher developing new curriculum that stimulates new learning, all of these individuals might be considered to possess potential talent that can be realized or are already manifesting some level of talent. Their talent might have developed in very similar or radically different fashions, considering the differences in their interests and background forces (e.g., parental guidance.) In the section below, factors and attributes that influence talent development are reviewed.

Factors and Attributes Influencing Talent Development. The three developmental components of talent, cognitive ability, personal-psychological attributes, and environmental-social factors, are reviewed. Each of these components differentially contributes to an individual’s characterization of sources for talent development, but all must be present in some amount to realize potential talents.

Cognitive ability. Cognitive ability refers to an individual’s analytical- and creative-thinking ability (Hong & Milgram, 2008a). Analytical-thinking ability has been identified as the intellectual factor that could be assessed as general and specific cognitive ability (Gagné, 2004; Livne & Milgram, 2006). Assessments of general
analytical-thinking ability (or intellectual ability) were once the standard for measuring potential talent (Sternberg, 1995; Terman, 1925). Today they are still considered an important component for identifying gifted students for special programs. Domain-specific analytical-thinking abilities are manifested in specific areas such as math or music (Hong & Milgram, 2008a; Song & Porath, 2005).

Analytical intelligence has been studied extensively in connection to talent and talent development (Gagné, 2004; Lubinski & Benbow, 2006; Terman, 1925; Tomlinson-Keasey, 1990). Often represented by the “Intelligence Quotient” (IQ), analytical intelligence has been measured by using one of many intelligence tests. The historically most prominent of these would be the Stanford-Binet Intelligence Scales (SB5; Roid, 2003), which is currently in its 5th edition, and Wechsler’s Adult Intelligence Scales, 4th edition, (WAIS-IV; Wechsler, Coalson, & Raiford, 2008). A strong relationship has been found between general intelligence (i.e., general analytical-thinking ability) scores and domain-specific academic achievement that requires analytical-thinking ability (Hong & Milgram, 1996). That is, individuals with high general intellectual ability have the tendency to do well in academic programs where most work involves analytical thinking. Students with high analytical intelligence can learn material not only faster than students of lower analytical intelligence, but can develop a heightened understanding of the material; it may have been a reason why early definitions of giftedness and identification and assessment of gifted children relied heavily, and often exclusively, on analytical intelligence (Gagné, 2004).

Creative-thinking ability is another important facet for the development of potential talent (Jackson & Butterfield, 1986; Sternberg & Lubbart, 1993). Creative
thinking can be described as thinking or problem solving that involves the construction of new meaning (Runco, 2003). Talented individuals have been viewed as having an inherent ability for creative thinking, exhibiting creative abilities, or generating creative products (Jackson & Butterfield, 1986; Sternberg & Lubbart, 1993). Ward, Saunders, and Dodds (1999) suggest that analytical- and creative-thinking abilities are related and that it is academically talented students’ greater intellectual capacity that allows them to demonstrate cognitive flexibility. This capacity leads them to produce more ideas that can be rated as original or creative. However, empirical studies on relationships between analytical- and creative-thinking abilities demonstrate low or nonsignificant relationships (Hong & Milgram, 1996; Milgram & Livne, 2005).

Creative-thinking ability has historically been considered domain-general. Recently, however, creative thinking has evidenced as domain- or task-specific (Kaufman & Baer, 2005). Whereas some researchers provide evidence for domain generality, referring to the predictive power of domain-general creative-thinking ability scores on subsequent creative achievement (Cramond, 1994; Torrance, 1981), others view the mental process of creative-thinking as domain-specific and contend that each domain requires different theoretical and operational definitions (Kaufman & Baer, 2005; Silvia, Kaufman, & Pretz, 2009). The Torrance Tests of Creative Thinking (Torrance, 1974) are one of the better-known domain-general creativity tests, which measure both verbal and non-verbal aspects of creative thinking. More recently, some researchers are recognizing creative-thinking ability as both domain-general and specific (Hong & Milgram, 2010; Plucker & Zabelina, 2009). Theories such as the Amusement Park Theory (Baer & Kaufman, 2005) demonstrate attempts by researchers to acknowledge the importance of
both domain-general and specific creative-thinking ability for understanding relationships of creative ability with creative outcomes. A moderate and positive relationship is demonstrated between domain-general and specific creative-thinking abilities (Hong & Milgram, 1996; Milgram & Livne, 2005).

In summary, cognitive ability, both analytical and creative, is the foundation of talent development and allows an individual to develop their potential to become an expert or creative talent in a domain (Hong & Milgram, 2008a).

**Personal-psychological attributes.** Motivation, self-regulation, and interest are some examples of attributes that are important sources for talent development. Motivation and interest offer students the desire to put forth the necessary effort to become successful in learning (Ackerman & Beier, 2003). Without the motivation to persevere through adversity, many individuals with potential talent will not be able to actualize their potential (Subotnik & Steiner, 1994). Rea (2001) describes achievement motivation as a combination of three factors: personal expectancy for success, subjective value of the task, and perceived enjoyment to be obtained from completing the task. Her concept of the motivated mind combines intelligence, creativity, and achievement motivation. By conceptualizing the mind as a complex and fluid mechanism, Rea attempts to explain the coexistence of intelligence and creativity and the importance of motivation in her theory of motivation.

Of the many motivational constructs, effort, goal orientation, intrinsic versus extrinsic motivation, interest, and self-efficacy are the focus of the current study. Dai, Moon, and Feldhusen (1998) contend that talented individuals are more likely to claim effort as the reason for academic success, whereas less talented individuals are more
likely to claim ability as the reason for academic success. By citing effort, talented students are self-enhancing and motivating themselves, because they feel in control of their own development (Dai et al., 1998). Amabile (2001) includes hard work and discipline in her description of successful talented individuals.

Goals can be defined as a set of behavioral intentions that influence how students approach and participate in learning activities (Meece, Blumenfeld, & Hoyle, 1988). Goals provide students with a measure against which they can monitor their learning progress (Hadwin, Winne, Stockley, Nesbit, & Woszczyna, 2001). Goal orientation describes the reasons students engage in various activities in order to meet their goals (Eccles & Wigfield, 2002) and is commonly divided into mastery goals and performance goals (Pintrich, 2003). Mastery goals are based on the belief that effort will lead to success, which is defined by self-referenced standards. Performance goals are based on the belief that learning is simply a means to an end, with the end often including a public demonstration of an individual's success (Ames & Archer, 1988; Elliot & Dweck, 1988). Performance goals are sometimes separated into two sub-categories: performance-approach goals and performance-avoidance goals. Performance-approach goals are set when a student is attempting to attain a positive outcome (i.e. receive the best grade in the class), whereas performance-avoidance goals are set when a student is attempting to avoid a negative outcome (i.e. avoid failing a course) (Elliot & McGregor, 2001; Pekrun, Elliot, & Maier, 2006). Much research has demonstrated that students often benefit most when they are focused on mastery or learning goals, because it propels them to learn more information about the topics in which they are interested (Amabile, 1985; Pintrich, 2003; Pintrich & De Groot, 1990; Sansone & Thoman, 2005).
Personal interest also plays an important role in the development of potential talent (Emmett & Minor, 1993; Sansone & Thoman, 2005). Interest keeps an individual focused on the task at hand, because they want to focus. A lack of interest will make it difficult for a person to care about their work and maintain the concentration necessary for advancement (Ackerman & Beier, 2003). When considering “why” students choose to complete a task, the theory of intrinsic and extrinsic motivations can offer some explanations (Eccles & Wigfield, 2002). Intrinsic motivation refers to the motivation to complete an activity for the joy or satisfaction of carrying out the activity itself and extrinsic motivation refers to the motivation to complete an activity with the expectation of external rewards (Deci, 1972). Pintrich (2003), in his summary of current motivational science perspectives, describes the continuum of internal to external motivation. He suggests that the more internalized the style of motivation, the more a student is likely to be engaged in school, to have better learning and performance, and to have a greater psychological well being. Intrinsic motivation is strongly related to the use of cognitive strategies, self-regulation, and persistence in academic work (Pintrich & De Groot, 1990). Although intrinsic motivation was not found to be directly related to student performance in their study, Pintrich and De Groot (1990) found that intrinsic motivation was very strongly related to student self-regulation and speculated that this relationship affected the student’s decision to become actively engaged in their academic work.

Whereas some researchers provide evidence that extrinsic motivation is less effective or even harmful in developing creativity (Amabile, 1983; Hennessey & Amabile, 1988) and that it has a negative effect on intrinsic motivation (Deci, 1971, 1972), more recently others have found that extrinsic motivation can have a positive
influence on creativity (Amabile, 1996; Collins & Amabile, 1999; Eisenberger & Cameron, 1996; Eisenberger & Rhoades, 2001; Eisenberger & Shanock, 2003).

Moderating effects of extrinsic motivation on creativity are often found in “workplace” environments; intrinsic motivation may provide challenge and interest, but it is frequently extrinsic motivation that ensures a complete and timely output of creative products (Amabile, 1993).

Self-efficacy is another component of motivation. Self-efficacy has been described by Bandura (1993) as “people’s beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives” (p 118). Self-efficacy beliefs are motivational as they allow people to set goals and anticipate outcomes of their actions. Pintrich (2003) contends that people’s expectation of success will lead them to try hard, persist, and ultimately perform better. A significant relationship between self-efficacy and achievement has been found in numerous studies (Areepattamannil et al., 2011; Bandura, 1993; Bandura et. al, 2001; Pajares, 1996; Pintrich & De Groot, 1990; Schunk, 1996; Walker, Greene, & Mansell, 2006). For example, self-efficacy and college GPA were positively related, after the effects of prior performance were removed (Elias & MacDonald, 2007).

One method used to evaluate interest and motivation is examining the extra-curricular activities that individuals have participated in earlier in their childhood or adolescence (Milgram & Hong, 1994.; Olszewski-Kubilius & Lee, 2004). These activities give insight into the areas individuals are interested in, because they want to be, not because they have to be. Milgram and Hong include activities such as solving math problems, scientific activities, writing short stories, and engaging in social leadership, to
assess students’ potential talent in various domains. High levels of activities in certain domains indicate individuals’ personal motivation and interest in those areas. Interests, activities, and accomplishments in adolescence and adult accomplishment are related; that is, when adolescent out-of-school activities match with adult occupation, they tend to have more work responsibility, higher work achievement, and more intrinsic satisfaction (Milgram et al., 1997).

In summary, an individual’s personal and psychological attributes play an important part in the development of talent (Hong & Milgram, 2008a). If students are not motivated to work hard or have a low starting threshold of potential, they are not likely to develop their talent to an extraordinary level.

**Environmental-social factors.** Physical and social environments can have a significant impact on an individual's effort to maximize their potential. Having access to a computer at home, having teachers specialized in gifted education at school, having a teacher who promotes creativity, or having a home environment conducive to learning and studying are examples of environmental factors that can influence the level of talent that is attainable by an individual. Parental expectations, peer taunts, or teacher support tend to affect how individuals view their place in society and how their talents fit (or do not fit) into that mold (Cross, Stewart, & Coleman, 2003; Dai et al., 1998; Flashman, 2012).

The presence of a mentor during the development of talented individuals is significant. Mentors are often individuals within the same discipline and offer students professional as well as emotional support (Cramond, 1994; Little, Kearney, & Britner, 2010; Rudnitski, 1994; Subotnik & Steiner, 1994). Subotnik and Steiner state that
Mentors are especially effective with female students. Mentors can help talented individuals visualize their life as a happy and creatively productive professional. Acting as a confidant, students can voice their misgivings about their field or environments to their mentors, which gives the opportunity for reassurance (Subotnik & Steiner, 1994). Mentors, including peer mentors, may help students with professional experience by introducing them to influential contacts (Rudnitski, 1994). By having a mentor, talented students are more likely to stay in a field of study and excel within it.

School environments play a major role in the development of potential talent. It has been documented that talented students need to be taught in a different manner than less talented students (Coleman, 2002; Dalzell, 1998; Morelock & Morrison, 1999; Tomlinson et al., 2003; Tomlinson-Keasey, 1990; Zimmerman & Martinez-Pons, 1990). In regular school settings talented students can gain one of two different self-perceptions. They might have a boost of self-confidence, since they know that they are “smarter” than most of their peers (Dai et al., 1998). If they were ridiculed or made fun of in school, students with talent potential may develop a lower self-esteem, decreasing chances to realize their potential, because they just want to be “normal” in order to “fit in” (Cross et al., 2003; Winner, 2000). When this same issue is approached from the viewpoint of exclusively talented schools or programs, the opposite effects may result. Talented students can feel as though they are equals and “regular” like the other students, keeping them from taunts about being different. On the other hand, talented students may have feelings that they are not good enough, because there are potentially quite a few students who are more advanced than they are (Cross et al., 2003). As can be seen, environment and personality interact in their effect on the individual’s talent development.
“Perception of self” is important when they decide whether or not to pursue their talent (Dai et al., 1998). Individuals with potential talent need to be aware that they have potential early in their lives. Classroom environment has a great impact on talent development. For example, the actual learning material presented to students and the manner in which it is presented influence academic development. Regular classrooms have the tendency to teach to the middle of the class. This can leave talented students bored and uninspired to learn, and this boredom may be demonstrated as a propensity to underachieve or get into trouble (Kanevsky & Keighley, 2003).

Gifted and talented (GATE) programs tend to shy away from the “middle of the class” theory (Reis, 2007). Scripp and Davidson (1994) support the idea that an individual’s talent can be enhanced with proper training. In specialized programs, talented students are more likely to find learning situations that are individually tailored and that move at a pace more conducive to their specific requirements (Tomlinson et al., 2003; Tomlinson-Keasey, 1990). It is important to note that not all regular classrooms ignore the talented student and not all gifted programs correctly differentiate curriculums to support individual students (Reis, 2007).

Family environment also influences developmental processes of an individual (Cho & Campbell, 2011; Winner, 2000). The social influence of family on child development tends to come in the form of parents attempting to guide children into a field that the parents think is best (Lubart, 1990). This is usually done with the best of intentions. Parents may suggest to artistically talented children that they get a “real job.” Alternately, parents with similar artistic inclinations to their children may be completely supportive. Walberg and Paik (2005) claim that parents “diversify” their child’s interests,
as a way to mediate the risk of failing to achieve greatness. Much of this has to do with the value set that the family has decided is important, and how a child’s talent supports this value set.

Gagné (2004) contends that significant people, often family members, are a major source of influence in talent development and that the environment that a family creates can be either conducive or non-conducive to developing talent. For example, when one or both of the parents of the potentially talented individuals are also talented in similar areas, the chance for children to model their parents increases and so does the chance for actualizing their potentials.

Social environments can also have an effect on talent development. The significance of friends (Field et al., 1998; Flashman, 2012; Riegle-Crumb, Farkas, & Muller, 2006) and the expectations of others (Emmett & Minor, 1993) are influences that can work either for or against talent development. High-achieving friends can positively influence students, especially females, to take advanced classes (Riegle-Crumb et al., 2006) and external expectations can significantly influence career decisions made by gifted students (Emmett & Minor, 1993). In fact, Field et al. (1998) found adolescent students to consider their friends to be more important than their families. It is apparent that the social environment influences gifted students in developing their talent.

In summary, cognitive ability, personal and psychological attributes, and environmental and social factors all work together to determine individuals’ potentials and the degree that they may realize their potentials (Hong & Milgram, 2008a). It is not only the intellectually brightest that become eminent in their specific domain as many once believed (Walberg & Paik, 2005). Although the mix of these components varies
among individuals, chances to become eminent are higher when all components are in place and maximally utilized.

**Domains of Talent.** Talent, especially in adults, is demonstrated in specific domains or areas. In fact, an individual’s strong talent potential is most likely to be demonstrated in one area (Achter et al., 1999; Milgram & Hong, 1999; VanTassel-Baska, 2005). Researchers have studied a few selected domains for the purposes of examining the relationships between them. For example, Matthews (1997) examined three domains representing linguistic, logical/mathematical, and social/emotional domains. According to Hong and Milgram (2008a) one may find group differences in cognitive ability, personal attributes, and environmental backgrounds, although individual differences within each group are also large.

Presented here are representative characteristics in three domains of talent that have been studied or discussed in literature: science, art, and social leadership. Talented individuals with developed strengths in the quantitative areas are likely to major in subjects such as physics and chemistry (Achter et al., 1999). Scientists are often preoccupied with things and ideas rather than people and feelings (Feist, 2005). They are often more interested in discovering truth rather than in aesthetic presentation. Furthermore, scientists express more confidence in their intelligence than in their creative thinking (Walberg & Paik, 2005). Individuals with quantitative strengths are usually identified by standardized aptitude tests such as SAT-math (Achter et al., 1999; Lubinski & Benbow, 1994, 2006).

Individuals with artistic strength are likely to choose to work in, visual art, creative writing, dance, or music. Artists are often preoccupied with communication of
inner feelings and express more confidence in their creative thinking rather than their intelligence (Walberg & Paik, 2005). Talented individuals in the artistic domain are identified through extra-curricular interests, activities, and accomplishments (Milgram & Hong, 1999) or interest scales (Achter et al., 1999; Allport, Vernon, & Lindzey, 1970), which measure individuals’ basic motives or interests.

Individuals with strong interest in social leadership possess philanthropic love of people and tend to be creative, risk taking, and intellectual, and have interpersonal communication skills (Ambrose, 2005; Rudnitski, 1994). Typical measures used to identify talented individuals in social leadership are activities and accomplishments (Hong et al., 1993) and general interest scales (Allport et al., 1970). Individuals with social leadership strengths tend to choose work that may lead them to pursue a position in which they can actively work with or lead people.

In summary, although the degree of influence of personal attributes and environmental backgrounds may vary widely, individuals with potential talents or demonstrated talents in each domain display distinctive characteristics. However, the important question is what makes talented individuals become talented in a specific domain. That is, whether there are discernible differences in these attributes and factors that influence the making of talented individuals in different domains should be examined. As Marland identified in 1971, “Intellectual and creative talent cannot survive educational neglect and apathy” (p. 6). The complex relationships between the person and the environmental factors need to be congruous to develop talent (Hong & Milgram, 2008a). That is, it is the system as a whole that allows potential talent to flourish.
The Study

Purpose

The study examined factors considered to influence individuals in the development of talent. Graduate students in three different domains were selected as they are viewed as having manifested a certain degree of strength or talent in their chosen domain. Graduate students from different areas were predicted to have different background and personal attributes, thus making it possible for the researcher to determine characteristic differences of these individuals from three domains. Specifically, this study examined (a) cognitive abilities, both analytical- and creative-thinking abilities, (b) personal-psychological attributes, including motivation, interest, and extracurricular activity participation, and (c) environmental-social factors that include social experiences in and out of school.

The three areas of study were Science, Arts, and Education. According to Biglan (1973) the subject matter of college departments can be classified along three dimensions (a) the extent to which a paradigm defines the scholarly area (“hard/soft” sciences) (b) the extent to which the subject can be applied, and (c) the extent to which the area deals with life systems. According to Biglan’s dimensions, science (physics and chemistry) is classified as a hard, pure, non-life discipline, education (teaching) as a soft, applied, life discipline, and art (music and creative writing), as a soft, pure, non-life discipline. These three areas were chosen in order to mirror the commonly studied areas of scientific and artistic talents, and to include the considerably less studied area of education.
Significance of the Study

This study has been conceptualized in order to fill the void of research comparing the developmental components of talent across disciplines with graduate-level students. Distinguished graduate students manifest a certain degree of talent in their selected area of study, thus allowing the researcher to study their talent, representing in-between minimal to profound level of talent (Hong & Milgram, 2008a). There have been more studies conducted on individuals displaying potential talent within a single domain, for example, mathematics (Lubinski & Benbow, 1994), music (Davidson & Scripp, 1994), and science (Subotnik & Steiner, 1994) than studies on multiple domains (Achter et al., 1997). The current study examined three domains simultaneously to compare characteristic differences of individuals.

The proposed study targeted graduate students who have demonstrated the potential to be successful and thus have been accepted into their program of choice. These graduate students should have developed their potential talents with the intent of becoming distinguished in their field. These students have persisted through undergraduate courses of study, where the less determined or motivated students have not (Subotnik & Steiner, 1994; Winner, 2000). On the other hand, these students have not been in a work environment long enough to have been dissuaded from their respective fields due to external factors such as office politics or lack of pay (Subotnik & Steiner, 1994).

This study is significant because it not only extends the existing knowledge base by exploring a new student population that exhibits some degree of talent that is further being developed, but also provides insight into fostering potential talent in children and
adolescents by exploring these students’ personal attributes and environmental background during adolescence.

**Research Questions**

The overarching question of the study is: Do graduate students across the three domains differ in their attributes and backgrounds? The following are specific research questions:

(a) Do graduate students from three domains differ in their (1) analytical- and creative-thinking ability, (2) adolescent motivation attributes, and (3) adolescent environmental backgrounds. This question was tested by a multivariate analysis variance and following univariate analyses of variance.

(b) Do graduate students from three domains differ in subscale scores in (1) creative-thinking ability, (2) adolescent motivation attributes, (3) adolescent environmental backgrounds, and (4) adolescent activities? This question was tested by profile analysis.

As indicated in the reviews of literature, most studies conducted in this area are single-domain based. Due to the lack of studies comparing personal attributes and environmental backgrounds across multiple domains, this study is largely exploratory in nature.

**Definition of Terms**

The following definitions are provided for constructs pertinent to this study.

**Analytical thinking:** The ability of a student to “analyze, critique, judge, compare and contrast, evaluate, and assess” (Sternberg, 2003, p. 5).
Cognitive ability: A dimension of talent development that encompasses analytical-thinking and creative-thinking (Hong & Milgram, 2008a).

Creative-thinking ability: “The interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful” (Plucker, Beghetto, & Dow, 2004, p. 90).

Environmental-social factors: A dimension of talent development that encompasses environmental and societal factors that can be manifested in school, society, or family dynamic (Hong & Milgram, 2008a).

Mentor: a wise and trusted counselor or teacher or an influential senior sponsor or supporter (Dictionary.com, n.d.).

Multipotentiality: “Individuals who have numerous and diverse abilities and interests” (Rysiew et al., 1999, p. 423).

Personal-psychological attributes: a dimension of talent development that encompasses personal and psychological attributes of a person, including motivation, interest, and biological ability (Hong & Milgram, 2008a).

Talent: “The outstanding mastery of systematically developed abilities (or skills) and knowledge in at least one field of human activity to a degree that places an individual at least among the top 10 per cent of age peers who are or have been active in that field or fields” (Gagné, 2004, p. 120).
CHAPTER 2

Literature Review

The literature review of topics related to this research is based on the developmental components that make up the basis of this study. The literature review primarily focuses on studies of gifted students within each of the developmental areas. As the study examined graduate students, preference was given to studies featuring adult learners. In order to demonstrate practical applications of theoretical concepts, applied and action research articles were reviewed when available.

The areas under review include cognitive ability, personal-psychological attributes, and environmental-social factors that were considered the three basic components of talent development (Hong & Milgram, 2008a). Cognitive ability includes primarily analytical-thinking ability and creative-thinking ability. Personal-psychological attributes include such topics as motivation among others (e.g., metacognitive, affective, sex, and other biological). The motivation section reviews the topics of effort, goal orientation, intrinsic and extrinsic motivation, interest, self-efficacy, and extracurricular activities. The environmental-social factors section explores school environments, family influences, social influences, and mentors.

The existing literature on the developmental aspects of giftedness illuminates a lack of research on graduate-level students' talents from different fields of study. This lack of research is addressed by this study. In the sections that follow, research that deals with each of the areas of development are reviewed. Topics and populations that specifically pertain to this study are highlighted.
Cognitive Ability

Gagné (2007), a prominent scholar in giftedness, considers intelligence and creativity as “natural abilities, whose development and level of expression are partially controlled by the individual’s genetic endowment” (p. 94). Although a portion of intelligence and creativity may be innate, it is the growth potential that they possess that makes them important components of Hong and Milgram’s (2008a) model, the Comprehensive Model of Giftedness and Talent (CMGT).

Cognitive ability, in this study, is defined as an individual’s analytical- and creative-thinking ability (Hong & Milgram, 2008a). Analytical-thinking ability, once the golden standard for measuring potential talent, is an intellectual factor that is expressed either in general or in a specific domain, such as literature or math (Gagné, 2004; Hong & Milgram, 2008a). Creative-thinking ability refers to thinking or problem solving that results in the construction of new meaning (Runco, 2003). Both of these abilities, manifested as general and/or specific abilities, are required to engage talent development (Hong & Milgram, 2008a).

Analytical-thinking ability. Some of the most prolific researchers in the field who related analytical-thinking ability to talent and talent development include Gagné (2004, 2007), Terman (1925), and Lubinski and Benbow (1994, 2006). Hong and Milgram (2008a) also discuss the effect of analytical-thinking on expert and creative talent. Gagné’s Differentiated Model of Giftedness and Talent (DMGT, 2004) illustrates the theoretical process of talent development in terms of natural abilities, interpersonal catalysts, environmental catalysts, and chance. Gagné describes natural abilities as relatively untrained or innate aptitudes in specific domains. His definition of giftedness is
based on natural abilities that place an individual in the top ten percent of similar age peers in a specific domain. Interpersonal catalysts include personal traits and self-management processes. Environmental catalysts include socio-demographic factors, emotional and psychological influences from others, or special programs designed to aid in talent development. Gagné’s definition of talent starts with natural abilities which are then manipulated by interpersonal and environmental catalysts and other catalysts (e.g. the talent development process and chance) to produce developed abilities and knowledge in a specific domain. The concept that talent can be developed is the key to the current study’s expectation that talents in specific domains demonstrate different developmental patterns.

Terman (1925) was interested in not only measuring how eminent minds of his time developed, but also what happened to individuals with potential talents that did not develop into eminent figures. Terman (1925) was able to attain access to about 1,000 elementary students and about 300 high-school students, all with IQ scores of 140 or higher. He was looking to collect longitudinal data to explain and quantify some of the characteristics of potentially talented students and how they developed over time. He used information from teacher recommendations and intelligence tests such as the National Intelligence Test Scale B (Whipple, 1921) and Stanford-Binet (Terman et al., 1917) to select participants in this study. The participants were then given domain-specific tests on information in science, history, literature, and the arts in order to identify the specialization of the participants’ abilities. They were also asked to name any ancestors of distinctly advanced ability to measure the potential hereditability of intelligence (Terman, 1925). He explained that childhood interest, combined with high
analytical ability, prepares individuals with potential talent for greatness as adults in all different types of academic and artistic fields. This interest allows individuals to expend the time and effort needed to develop their talents into greatness. Terman (1925) wanted to learn all that he could about the development of talent from students who showed high levels of potential talent in the form of high analytical ability. Although findings from his work can be found in various literatures (see Burks, Jensen, & Terman, 1930; Cox, 1926; Terman, 1925; Terman & Oden, 1947; Terman & Oden, 1959), the relevance of the Terman legacy to the current study is that it initiated the concept of analyzing individuals within their specific types of academic fields. Grouping the participants by field allows conclusions to be drawn about the make-up of the groups and the differences among the groups, which is the focus of the current study.

Hong and Milgram (2008a) also state that analytical-thinking ability is very important when formulating expert and creative talent, although its importance on talent development is more prominent in expert talent (see more under creative-thinking ability). Development of expert talent requires in-depth education and intense training and practice. Experts of many different domains will use their analytical abilities to survey situations before taking action. The analytical experts’ first inclination, when faced with a problem, will be to come up with one “correct” solution, as opposed to finding multiple possible solutions, which is a tendency manifested by individuals with creative talent (Hong & Milgram, 2008a).

Exploring the developmental processes involved in the transformation of mathematical and verbal precocity into adult achievement, the Study of Mathematically Precocious Youth (SMPY) is a 50-year longitudinal study that was initiated in 1971.
(Lubinski & Benbow, 2006). This study focused on understanding the unique personal and educational requirements of extremely intellectual students, what affects their developmental paths, and how education affects talent development. Five cohorts, representing about 5,000 students, were used to group participants by start date and location (e.g. Cohort 1 participants were identified between March of 1972 and January of 1974 and were from Baltimore, Maryland). Most students were identified around age 12 or 13. Selection into the study was completed after the students scored in the top 3% of their peers on the Iowa Test of Basic Skills and then scored at least 390 on the SAT-M or 370 on the SAT-V. Using the theory of work adjustment (TWA, Dawis & Lofquist, 1984; Lofquist & Dawis, 1969, 1991), the researchers organized variables that were important to educational, counseling, and industrial psychology, while assessing both the participants and their environments. They thought that these three areas would be important in the development of the participants from young student to professional adult. Throughout the cohorts, Lubinski and Benbow (2006) found that there was quite a difference within the “top 1%” on measures such as degrees earned, prestigious academic positions earned, and earning potential. Within the top 1% of students there is a wide range of cognitive abilities and this range allows for differential results as adults. They found that more cognitive ability is always better. They also found that abilities that are more pronounced in one area (e.g. mathematics) would tend to predict future preferences by the participants. Lubinski and Benbow (2006) were using factors of cognitive intelligence and educational environment to determine how future students of extreme potential should be educated in order to support the development of their maximum potential. This approach mirrors the ultimate goals of the current study, to identify factors
that can encourage talent development. Although their study has the advantage of being longitudinal in nature, the SMPY focused on students with mathematical talents, whereas the current study looks at multiple fields of study.

**Creative-thinking ability.** Unlike analytical thinkers, who strive to find the most correct answer to a problem, creative thinkers are often focused on finding multiple and unique answers to problems. The relationships between the different types of cognitive abilities (e.g., analytical-thinking ability and creative-thinking ability) have low relationships (Hong & Milgram, 1996; Livne & Milgram, 2006). In their study of Israeli adolescents, Hong and Milgram (1996) explored the relationships between general intellectual (or analytical) ability, intellectual ability in a specific domain, general creative-thinking ability, and creative talent in a specific domain. The researchers used the domain of literature in order to measure specific analytical and creative ability. They found that four of the latent factors studied had low to moderate coefficients. The strongest relationships were found between factors that were conceptually considered related (i.e., general intelligence and specific intelligence and between general creativity and specific creativity). The weakest relationships were between factors that were conceptualized as unrelated (i.e., general intelligence and specific creative ability). The relationship between the factors of general intelligence and general creative-thinking ability was moderate, as was the relationship between the specific intelligence and specific creative ability. This suggests that the four dimensions of abilities were found to be related yet relatively independent.

In much the same manner as above, Livne and Milgram (2006) sought to determine the relationships between creative and academic abilities as was demonstrated
in the field of mathematics. The researchers found that general creative-thinking ability predicted domain-specific creative-thinking ability in mathematics and that general intellectual ability predicted domain-specific academic ability in mathematics. Neither of the general intellectual and academic mathematic abilities was significantly correlated to either of the creative abilities. The findings on these relationships have important implications in the identification of talent in individuals. If only one type of ability is measured (e.g., intelligence), some talented individuals are likely to be mislabeled as non-talented. The results of these studies informed the current research of the importance of including both analytical and creative ability, in an effort to determine whether these abilities are related by the specific domain of study the graduate students chose to pursue.

Using the predictive power of general creative thinking scores on subsequent creative achievement, some researchers support the domain general nature of creativity (Cramond, 1994; Torrance, 1981). Others view the mental process of creative thinking as domain-specific and contend that each domain requires different theoretical and operational definitions (Kaufman & Baer, 2005). More current research has supported the postulation that domain-general and domain-specific creative-thinking abilities are distinguished as separate constructs but also related, with the former influencing the latter (Hong & Milgram, 2010; Kaufman & Baer, 2005).

Some studies have demonstrated that creative thinking is domain (or task) specific (Kaufman & Baer, 2005; Silvia, Kaufman, & Pretz, 2009). As editors to their book on creativity, Kaufman and Baer (2005) acknowledged the general contention among researchers as to whether creative ability is a general trait or a domain-specific trait. They concluded that creative ability can demonstrate as both domain-general and domain-
specific and that micro domains should be created, in order to explain some of the
cognitive process differences between domains that seem very closely related.

This research supports, and is informed by, the Amusement Park Theory of
creativity (Kaufman & Baer, 2005). This theory attempts to bridge the domain-general
and domain-specific theories of creativity. It describes general traits that must be present,
potentially in varying amounts, in order for creativity to develop. These traits include
“intelligence, motivation, and environment” (Kaufman & Baer, 2005, p. 159). Individuals
become engaged in one general thematic area, assuming that they have the prerequisite
skill set to affect creativity in that area. From the general thematic areas, a domain is
chosen which will narrow the scope of the theme. Finally, from the domain, specific tasks
are chosen. These micro domains will highlight creative talents of an individual. This
theory was ultimately based on the concept that individuals possess a certain set of skills
and traits. These attributes may be applicable across many domains, a limited set of
domains, or only a single domain. Observing traits that present themselves across many
domains will lead to a view that creativity is relatively domain-general, but observing
traits that are applicable to a single domain will result in an opinion that creativity is
relatively domain-specific. Kaufman and Baer (2005) contend that creativity is actually a
combination of domain-general and domain-specific competencies.

Research on the domain-generality of creativity can largely be separated into
studies that measure creative accomplishments and those that measure creative-thinking
ability. Silvia et al. (2009) conducted a study on creative “accomplishments” and creative
self-descriptions using latent class analysis. They determined that prevalent methods of
testing domain-generality or specificity using multivariate statistics were less than ideal.
This judgment was based on their identification of three major problems. First, the multivariate statistics assume a homogeneous population, with no “clumpy samples.” Second, the authors claimed that factor analyses favor domain-generality, since all participants will be given values on each factor, when perhaps a null value is more appropriate. Finally, null effects are often attributed to domain-specificity when it may just be an extenuating outcome of low power, methodological weakness, etc. Silvia et al. (2009) contend that, when using latent class analysis, if the data on creative accomplishments or self-descriptions is best separated into more than two classes, and if these classes differ in class structure, then there is support for domain specificity of creativity. Silvia et al. (2009) conducted research studying the domain-generality of creative accomplishments and the self-reported descriptions of creativity. On the test of creative accomplishments, three classes were found: no creativity, visual arts, and performing arts. These classes varied by openness to experience, extraversion, and college major. This supports their theoretical definition that an individual’s accomplishments follow a domain-specific rather than domain-general pattern. The results replicate previous studies where creative products were examined (e.g., Baer, 1998, 2003). Many creativity related studies, unfortunately, did not distinguish creative-thinking ability and creative products/accomplishments in their studies of domain specificity/generality of creativity, requiring additional studies for clarification (Hong, in press).

Silvia et al. (2009) also tested creative self-descriptions, finding a different pattern from those of creative accomplishments. With the self-description data, categorizing them into classes was not as clean, with similar class separation values for 2 to 7 groups.
These classes also did not vary in structure, but rather in amount of self-reported creativity. This is much more indicative of domain-general creativity. The researchers concluded that there may be domain-general creative traits that fuel domain-specific creative activities.

Hong and Milgram (2010) explored the domain-general versus domain-specific question within creative-thinking ability, by not only looking at the relationship between them, but also the effects of gender, age, ethnicity, and learning disability on general and specific creative thinking. They tested various age populations ranging from kindergarten through college students. The participants were given measures to test domain-general creative-thinking ability and context-specific creative-thinking ability. They found that domain-general and domain-specific creative-thinking ability was distinguishable. It was also found that domain-general abilities had a direct effect on domain-specific abilities. Although the effects of gender, age, ethnicity and learning disabilities could be seen on the domain-specific aspects of creative-thinking ability, there were no effects observed on the domain-general aspects. These results caused Hong and Milgram (2010) to ponder the nature of creative-thinking ability. They proposed that perhaps there is an overarching, in-born trait associated with domain-general creative thinking ability, much like the g-factor of intelligence. The domain-specific abilities are then affected by individuals’ life experiences and learning, shaping their creative-thinking abilities in a specific domain in which they are engaged in developing their creative performance. These studies demonstrate that examining differences among graduate students from alternate domains of study might shed more light on whether creative-thinking ability differs across domains. In Hong and Milgram (2010), graduate students were not tested. As individuals’
interest and expertise crystallize as they get older, general creative-thinking abilities may differ across domains, which would be an interesting concept to examine.

**Personal-Psychological Attributes**

The personal-psychological attributes in the Hong and Milgram (2008a) address topics such as motivation, biological factors, personality, metacognition, and others. In this section, various motivational attributes examined in this study will be examined.

**Motivation.** Motivational theories are concerned with the energization and direction of behavior. According to Pintrich (2003), the term *motivation* is derived from the Latin verb *movere*, which means to move. That is, motivational theories attempt to answer questions about what gets individuals moving (energization) and toward what activities or tasks. The study of motivation can be focused on one or a combination of many elements, such as effort, goal orientation, intrinsic and extrinsic motivation, interest, and self-efficacy; literature on each of these motivational elements were reviewed.

**Effort.** Effort is often seen as an outcome of a student’s motivation. The more effort afforded to a task, the more likely that success will be attained. Effort seems to resonate especially well with gifted students (Chan, 1996; Dai, Moon, & Feldhusen, 1998; Hong & Aqui, 2004), and it is also a key component to developing creative abilities (Amabile, 2001).

Chan’s (1996) study of Australian 7th grade gifted and non-gifted students led to some interesting results. She found that gifted students were more likely to be confident in having greater control over their successes and failures than non-gifted students. By attributing successes or failures to the amount of effort extended, the gifted students
placed confidence in their abilities to perform on tests. Gifted students perceived that failures occurred not because they could not learn the material or they were unlucky, but because they did not make the choice to learn the material adequately. Chan also found that gifted students were more aware of metacognitive strategy use and they performed better on reading comprehension tests than their non-gifted counterparts. Few gender differences were found in this study.

Hong and Aqui (2004) studied some of the cognitive and motivational differences between academically gifted, creatively gifted, and non-gifted adolescents. Measures included domain-general and domain-specific (mathematics) cognitive and motivational constructs, extra-curricular mathematical activities, and standardized midterm exam scores. The academically gifted group scored high on the mathematical achievement measure, but low on the extra-curricular mathematical activity measure. The creatively gifted group scored below the academically gifted group on the achievement measure, but high on the extra-curricular activity. Finally, non-gifted students scored relatively low on both measures. Students who did not fall into one of these categories were removed from the study. Hong and Aqui (2004) found that creatively talented students tended to use more cognitive strategies than students in the other two groups. Academically talented females reported expending more effort than their male counterparts and creatively talented males more than did the academically talented males. The non-gifted students reported lower scores than both of the gifted groups on general self-efficacy, use of cognitive strategies, perceived math ability, math self-efficacy, and the value of learning math. These results indicate not only that there is a difference in motivation and
cognitive strategy use between gifted and non-gifted students, but that there is also a difference within the creatively talented gifted students.

Within their discussion of achievement motivation in gifted students, Dai et al. (1998) proposed theories about effort attributions. While reviewing other articles on the various topics of achievement motivation (e.g., Chan, 1996), the authors drew some specific conclusions. They claimed that by attributing failure to a lack of effort, gifted students protect their self-concept of academic ability. Gifted students perceived that they failed not because they could not do the task but because they just did not try hard enough. Attributing success to effort will not only demonstrate a perceived self-awareness of ability, but will also give the student a motivational boost. The students are additionally motivated to try hard and excel, since they have claimed control over some of their success, not just leaving it to chance with their in-born intellectual traits.

This perception of effort was also supported in a qualitative study on creativity (Amabile, 2001). According to Amabile (2001), hard work is one of the key factors in developing creativity. In her recounting of an interview with John Irving, a famous creative writer, she stated that he often writes up to 10 hours per day. Amabile quoted him as saying, “Do you know of anyone who goes to the Olympics without working at it ten hours a day?” (cited in Minzesheimer, 1998, p.3). The concept that talented individuals must work hard in order to succeed is found not only in academic achievement, but also in other domains of talent. Amabile (2001) took the position that the development of creativity need not rely solely on the presence of talent, but can be supplemented with effort and intrinsic motivation.
As reviewed above, self-reported effort expenditure has shown to be different across students with different backgrounds (Chan, 1996; Dai et al., 1998; Hong & Aqui, 2004). Whether similar differences exist in the graduate students with potential talent in various domains of study will be examined to add more understanding in the literature.

**Goal orientation.** Goals are important because they give the student a measure against which they can monitor their learning progress (Hadwin, Winne, Stockley, Nesbit, & Woszczyna, 2001). Goal orientation is commonly divided into internal or mastery goals and external or performance goals (Ablard & Lipschultz, 1998; Pintrich, 2003; Pintrich & De Groot, 1990). Mastery goals help students concentrate their effort on learning and understanding, developing new skills, and realizing a state of self-improvement, which is measured by self-referenced standards (Pintrich, 2003). Performance goals are primarily concerned with comparing student abilities with others. Performance goals place an emphasis on demonstrating ability, and gaining recognition for abilities and actions. They also focus on competition with other students (Pintrich, 2003).

Goal-orientation theories postulate that students identify learning goals and structure their learning processes around them (DeShon, Brown, & Greenis, 1996; Kanfer & Ackerman, 1989; Phillips, Hollenbeck, & Ilgen, 1996; Sansone & Thoman, 2005). The types of goals students set have an effect on their academic behavior (Pintrich & Schunk, 2002). Likewise, teachers’ goal orientation also have an effect on their teaching behavior; for example, teachers of gifted programs, as compared to teachers of regular classrooms, have more of a tendency to use mastery goal structure than performance goal structure (Hong, Green, & Hartzell, 2011).
Students’ adoption of difficult, yet personally attainable, goals and their perception that they are capable of achieving these goals activates self-regulatory processes (DeShon et al, 1996; Kanfer & Ackerman, 1989). These self-regulatory processes help the student manage and control their effort on academic tasks (Pintrich & De Groot, 1990), which allows them to optimize their abilities of attaining their goal.

Pekrun, Elliot, and Maier (2006) sought to find relationships between certain emotional states and each goal orientation. In their study performance goals were separated into two categories: performance-approach goals and performance-avoidance goals (Elliot, 1999; Pekrun et al., 2006). Performance-approach goals are characterized by students focusing their attention on attaining positive outcomes of value (i.e. I want to have the highest GPA in school). Performance-avoidance goals direct student attention on the attempt to avoid negative outcomes (i.e., I don’t want to fail the test.) (Pekrun et al., 2006). Further, mastery goals were positively related to enjoyment of learning, hope, and pride, and negatively related to boredom and anger about learning. Performance-approach goals were positively related to pride. Performance-avoidance goals were positively related to anxiety, hopelessness, and shame (Pekrun et al.). These results demonstrate how student goal orientation can influence student achievement emotions.

Whether mastery goal orientation is more beneficial to student learning over performance goal orientation has been of concern, as the former had been viewed in general as more effective for achievement. Elliot and Harackiewicz (1996) sought to find if there was a difference between students who were assigned to mastery, performance-avoidance, or performance-approach goal orientations. In two similar experiments, college undergraduate students were randomly placed into three or four treatment...
groups—mastery, performance-neutral (first experiment only), performance-avoidance, or performance-approach groups. A significant difference was not found between the groups on their value of competence, task performance, or effort expended on the research task. The only significant difference was that participants in the performance-avoidance group reported a lower level of intrinsic motivation. This lends support to the concept that performance goal orientations are not necessarily detrimental. Performance-avoidance goal orientations, those where the individuals are attempting to avoid failure, can lead to less task enjoyment and decreased intrinsic motivation. These findings supported the idea that mastery and performance-approach goal orientations can both be beneficial to individuals.

Vansteenkiste, Timmermans, Lens, Soenens, and Van den Broeck (2008) sought to test the theory that if student goal orientation is matched with the framing of lessons in the same orientation, then learning and achievement should be enhanced. This is known as the match perspective. The alternative to this point of view is often the one derived from the self-determination theory (Deci & Ryan, 1985, 2000; Ryan & Deci, 2000) that suggests intrinsic goals as preferable goals to extrinsic goals in a learning context. Weeks after testing fifth- and sixth-grade students on their goal profiles, students were given an activity about supporting a tuberculosis foundation. Vansteenkiste et al. found that their participants all had higher autonomous motivation, conceptual learning and persistence when the intrinsic goal framing was used, regardless of their personal goal orientation, supporting the concept of exclusively using intrinsic values when creating learning activities.
Relating the development of goals to past performance, Phillips et al. (1996) based their research on the differences between the motivational aspects of control theory and self-efficacy theory, examining the relationship between the level of goals that people set for themselves and each person’s past performance. According to control theory (Carver & Scheier, 1981, 1985) people base their future goals strictly on past performance. Self-efficacy theory (Bandura, 1977, 1991) asserts that people tend to take their past level of performance and incrementally increase it when developing future goals, assuming a positive self-efficacy perception. Phillips et al.’s findings depict a much more complex phenomenon involving strategic deliberation. They found two anomalous ways of developing goals. The first was displayed by participants whose past performance was poor compared to others, but their goals were the same as the others. The second was displayed by participants who had relatively high goals, although they had not performed significantly different than the others on past tasks. These results suggested that performance discrepancy creation, when people set higher goals than what past performance would subscribe, does occur in a multitask environment, and that neither control theory nor self-efficacy theory adequately describes the goal setting process.

Goal orientation addresses the manner in which students formulate their expectations of success on future learning objectives. The current study explores the use of mastery and performance goals between majors. Understanding what type of goals the students are setting allows for an adaptation of their learning environment to maximize goal attainment. Whether there are differences in the type of goals among the current
study’s graduate students in three domains of study would add more understanding to this goal phenomenon.

**Intrinsic and extrinsic motivation.** Intrinsic motivation triggers when individuals engage in a task because they are interested in it and it holds internal meaning for them, whereas extrinsic motivation activates when an individual is primarily concerned with external goals, such as rewards or the expectation of evaluation (Amabile, 1985).

Numerous studies have examined the relationships of intrinsic and extrinsic motivation with achievement and creativity (Amabile, 1985; Amabile, Hennessey, & Grossman, 1986; Cameron & Pierce, 1994; Deci, 1971, 1972; Deci & Ryan, 1985; Eisenberger & Cameron, 1996; Eisenberger & Rhoades, 2001; Hennessey & Amabile, 1998; Ryan, 1982).

The effect of external, or extrinsic, rewards on intrinsic motivation has become a somewhat controversial topic among researchers (Cameron & Pierce, 1994; Deci, Koestner, & Ryan, 2001; Eisenberger & Shanock, 2003). Cameron and Pierce (1994), in their meta-analytic study, concluded that reinforcement and rewards do not negatively affect intrinsic motivation, except under special circumstances. Asserting that rewards are detrimental to intrinsic motivation, Deci et al. (2001) completed a meta-analysis on the same, and additional, studies as Cameron and Pierce. Their goal was to support their previous research on the negative effects of rewards (Deci, 1971, 1972; Deci & Ryan, 1985; Ryan, 1982), while bringing into question the methods of Cameron and Pierce. Eisenberger and Shanock (2003) attempted to bridge the conflict with their article that questions the findings of both previous meta-analyses. Their findings supported the use
of performance based rewards to increase intrinsic motivation and creativity, but not the use of non-performance based rewards. These studies are further described below.

Cameron and Pierce (1994) examined 96 studies on reinforcement, rewards, and intrinsic motivation. They found that verbal rewards produced an increase in intrinsic motivation and tangible rewards did not cause an effect when they were delivered unexpectedly. When tangible rewards were expected, they were not detrimental to intrinsic motivation. Rather they could be considered beneficial to intrinsic motivation when it was measured by participant attitude. The only circumstance that was found to have a negative effect on intrinsic motivation was after a tangible reward was offered, regardless of level of performance, and then removed. Cameron and Pierce theorized that since there is such a problem with operationalizing the construct of intrinsic motivation, and since there is a large variation in the instruments measuring it, perhaps it is better to adopt a more behavioralist view and focus on the effects of rewards on behavior. This would lead to the abandonment of Deci and Ryan’s (1985) cognitive evaluation theory.

Any external events, such as rewards or evaluations can be seen as potentially affecting a person’s self-perceived competence and may enact control over their decision to engage in an activity for internal reasons. Deci et al. (2001) call into question the results of Cameron and Pierce’s (1994) meta-analysis with their meta-reanalysis. Claiming “inappropriate procedures” and “numerous errors” (p. 2), Deci, Koestner, and Ryan (1999) conducted their own review and meta-analysis, using the same studies as Cameron and Pierce, with the inclusion of 34 additional studies and dissertations. Their findings were quite different. Tangible rewards in all situations were detrimental to both free-choice intrinsic motivation and self-reported interest. Verbal rewards were found to
increase intrinsic motivation in college students, but not in children. This increase could be negated, however, if the results were given with a controlling interpersonal style. With the results of their study, Deci et al. (2001) contend that intrinsic motivation should be promoted, instead of tangible rewards, to affect student learning.

Providing what they claimed to be an amelioration of both the pro- and anti-reward theoretical groups, Eisenberger and Shanock (2003) described a theoretical scenario that considers both perspectives while evaluating creativity. The authors thought that each theoretical group had developed in isolation and they were unwilling to re-evaluate their theories in order to compromise between the two groups. They claimed that Romanticist (anti-reward) theorists focused almost exclusively on the contribution of perceived self-determination to creativity and intrinsic motivation. Their theory posed that the elimination of societal restraints on freedom, potentially including reward based tasks, could foster creativity (Rogers, 1954). Deci and Ryan (1985) explained how individuals perceived rewards that were offered for enjoyable tasks as an attempt to control their behavior, thereby reducing intrinsic task interest through the mediator of perceived autonomy. Romanticist theorists have occasionally allowed for rewards as a potential vehicle for information about performance that would enforce an individual’s sense of competence (Deci et al., 2001). Contrary to these beliefs, Eisenberger and Shanock contend that behaviorist perspectives focus on the assertion that rewards increase performance, including novel or creative performance (Skinner, 1953). In an attempt to make sense of these two opposing viewpoints, Eisenberger and Shanock came to several conclusions. First, rewards can increase creative performance, if they are combined with cues or instructions indicating the creative nature of the task. Secondly, if
creative performance is not specified, creative performance often decreases. Eisenberger, Rhoades, & Cameron (1999) found that in everyday life people are more likely to be rewarded for conventional, rather than creative, behavior. Therefore, if a reward is offered without specifying that creative performance is preferred, the individual is likely to assume that conventional behavior is expected. Eisenberger and Shanock stated that intrinsic motivation does not necessarily equate to creative behavior and that just because a person has a strong interest in a topic does not mean that they will choose to act in a creative manner. They found that by encouraging creativity, through the use of rewards and the request for creative behavior, the likelihood of creative outcomes was increased. The current study attempts to explore various motivational attributes of graduate students from different fields, adding more understanding to the intrinsic and extrinsic motivation phenomenon.

**Interest.** Another motivational attribute that is important to the development of talent is interest. Interest can be defined as a “phenomenological experience involving both cognitive and affective components. Attention is directed and focused, and the general affective tone is positive” (Sansone & Thoman, 2005, p 175). Interest has been positively linked to learning and talent development (Sansone & Thoman, 2005; Ainley, Hidi, & Berndorff, 2002). Students who are interested in learning about specific topics are more likely to focus and attend to them and ultimately further the development of their talent in that area. Interest is not only a factor in learning, it can also play an important role in a student’s long-term decisions about their career and future studies (Emmett & Minor, 1993).
Exploring the relationship between interest and self-regulation, Sansone and Thoman (2005) detailed how task choice and persistence were influenced by the anticipation of, or experience of, interest. They related interest to self-regulation through the mediaries of goals and intrinsic motivation. Since self-regulation is influenced by intrinsic motivation and the desire to attain goals, and interest would increase the intensity of both of these factors, interest should be an important component of self-regulation. Sansone and Thoman’s (2005) research demonstrated that without some level of interest on the part of the student, motivation relies exclusively on external factors such as rewards. Without topic or contextual interest, increasing student motivation and learning is less likely successful.

Ainley et al. (2002) also investigated the intermediary variables that link interest and learning. They used text comprehension to measure how interest related to affective responses, persistence, and comprehension. Using computers to assist in measuring behavioral choices of the participants, the researchers were able to analyze more completely the choices of the participants. Their findings suggested that topic interest was related to affective response, there was then a relationship between affect and persistence with the text, and finally, persistence was related to learning. That is, they found that topic interest was related indirectly to learning.

Interest can also be found in discussions of career choice. When individuals decide on a career, they are often making a statement about what interests them and which talents they want to develop further. Emmet and Minor (1993) completed a qualitative study that studied some of the factors that influence career decision-making in gifted students. They found that some of the participants had difficulties deciding upon
which of their interests they wanted to pursue a career in, and some felt that they had a very limited set of career options based on their interests. The most frequently mentioned obstacles regarded their sensitivity to others’ expectations and perfectionism. Perfectionism portrays gifted students’ feelings that the career that they choose would allow them to maximize their potential, fulfill their need to excel, and make a difference in the community, while balancing their fears that they would not have enough ability for a particular occupation. These findings are important because although interest does play a part in gifted students’ career choices, other factors may be as important, if not more.

Interest has been shown to affect learning (Ainley et al., 2002; Sansone & Thoman, 2005) and career selection (Emmet & Minor, 1993). It affects not only how students learn and what they choose to learn, but also how they approach their futures. The current study examines adolescent interests in order to extend previous findings by comparing across domains.

**Self-Efficacy.** Bandura (1993) defines self-efficacy as “people’s beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives” (p 118). Using this definition, it is conceptualized that self-efficacy beliefs influence behavior by affecting individual’s choices, effort, perseverance, and their thought patterns and emotional reactions (Pajares, 1996). Since self-efficacy is related to these areas, it is reasonable to expect that academic performance can and will be affected by self-efficacy (Areepattamannil, Freeman, & Klinger, 2011; Pajares, 1996; Walker, Greene, & Mansell, 2006). Self-efficacy is often based on prior experiences (Schunk, 1996). An individual’s self-efficacy can be an important factor in career choice (Bandura et al., 2001). It functions as a facilitator for cognitive engagement (Linnenbrink
& Pintrich, 2003; Pintrich & De Groot, 1990; Walker et al., 2006) and is additive to prior performance in the prediction of current performance (Elias & MacDonald, 2007).

There is a large body of research that focuses on the effect of self-efficacy on achievement or performance. Performance can be measured in specific areas, such as math (Pajares, 1996) or science (Areepattamannil et al., 2011). It can also be measured in more general terms, such as the use of self-regulated learning strategies (Pintrich & De Groot, 1990), cognitive engagement (Walker et al., 2006), and college academic performance (Elias & MacDonald, 2007). Examples of these types of studies are considered below.

Examining the predictive and meditational role that self-efficacy had on mathematical performance in both gifted and non-gifted middle school students, Pajares (1996) found that in gifted students, self-efficacy made an independent contribution to the prediction of math achievement, with other variables such as sex, math anxiety, cognitive ability, and others being controlled. Gifted students also reported higher levels of math self-efficacy, self-efficacy for self-regulated learning, math performance scores, and lower levels of math anxiety than did non-gifted students. He also found that gifted girls scored similarly to gifted boys in self-efficacy, anxiety, and self-efficacy for self-regulated learning, even though they out-scored the gifted boys in performance. His analysis supported the concept that self-efficacy plays a predictive and mediational role on math performance and that there are significant differences between the self-efficacy scores of gifted and non-gifted students on math measures.

Areepattamannil et al. (2011), examining the effects of self-efficacy, self-concept, enjoyment of science, interest in science, and instructional practices on science
achievement, found that adolescents’ higher levels of self-efficacy and self-confidence had a very strong, positive relationship with higher achievement in science. They also found that although enjoyment of science and “hands-on” instructional practices also held positive relationships with achievement, interest in science and “student investigation” based instructional practices had negative relationships with achievement. The unexpected negative relationships may have been an artifact of the test construction of the Programme for International Student Assessment (PISA) (OECD, 2006). Each of the unexpected results was congruent with cited previous research. Interest in science was compared with Shen and Tam’s (2008) study on student achievement and self-perception, and the finding on teaching practices was in line with a study using the PISA with Finnish students (Lavonen & Laaksonen, 2009). In their analysis, Areepattamannil et al. (2011) found that fostering positive self-efficacy and a positive self-concept could enhance science learning by adolescents.

The effect of self-efficacy on academic performance has also been studied in the context of self-regulated learning. Pintrich and De Groot (1990) found a positive relationship between self-efficacy and both cognitive engagement and performance. Their analysis, however, suggests that self-efficacy is primarily a facilitator for cognitive engagement, which is more directly associated with actual performance. The results confirmed the implication that self-efficacy supports the engagement in cognitive strategies, self-regulation, and metacognitive strategies, but a direct effect was not supported by this study.

Looking to counter the traditional trends of using external student factors, for example, race, gender, and socioeconomic status, to predict academic success, Walker et
al. (2006) examined internal student factors such as self-efficacy and internal/external motivation and their effects on cognitive engagement. They found that self-efficacy, intrinsic motivation, and academic identification all made unique contributions to students’ meaningful cognitive engagement. In Greene and Miller (1996) meaningful cognitive engagement predicted positive achievement.

When testing the effect of self-efficacy on academic performance it is important to partial out the effect of past academic performance. When past performance is removed from the relationship, additional differences in current performance can be attributed to self-efficacy (Elias & MacDonald, 2007). Elias and MacDonald studied the relationships between prior academic performance, academic self-efficacy, proxy-efficacy, and current college performance, defining proxy-efficacy as the belief that others (e.g. the university faculty) will function effectively on the behalf of the students. They found that high school academic performance was significantly related to academic self-efficacy for college and to current college performance, and academic self-efficacy beliefs account for a significant level of unique variance in current academic performance, after past performance has been taken into account.

Self-efficacy does not only affect the academic performance of students, but also has a significant relationship to how they select their careers. Bandura, Barbaranelli, Caprara, and Pastorelli (2001) researched how academic self-efficacy can influence career choice in Italian middle school students. They found that high levels of academic self-efficacy are directly and positively related to the choosing of careers in science and technology, educational and medical fields, artistic and literary pursuits, and management of business and social service systems. Ultimately, it was the students’ perceived
efficacy, rather than their actual achievement, that determined strongly their preferred occupational choices.

As demonstrated in the research discussed above, higher levels of academic self-efficacy have a positive relationship with academic achievement. When students evaluate their past performance and believe that they are capable of excelling at a task, they have a better chance of actually succeeding at it. The current study examines graduate students who have shown certain levels of excellence in their fields to determine if there is a significant difference in adolescent self-efficacy among them. Because the participants can be considered to be achieving a degree of success, one would expect their adolescent self-efficacy scores to be relatively high.

Motivation is a multi-faceted construct. By examining widely studied theories of motivation in the current study, a relatively comprehensive adolescent motivational profile of the participants from each major will be attained.

**Activities.** The activities, both in school and out of school, in which individuals choose to participate during their adolescence often indicate both their specific areas of interest and potential career paths (Milgram, Hong, Shavit, & Peled, 1997; Milgram & Hong, 1994). Adolescent participation in extracurricular activities often occurs when individuals have a specific interest in the activity and the motivation to pursue their interests. The participation in extracurricular activities has been related to higher levels of general scholastic achievement (Reis, Colbert, & Hébert, 2004).

Individuals participate in extracurricular activities often because of personal interest. Milgram et al. (1997) found a positive relationship in gifted individuals between extracurricular activities and vocational choice. For those individuals with matching
domains of adolescent activities and adult vocation, their levels of self-reported work
accomplishments and work satisfaction were higher as compared to those with non-
matching domains (Milgram et al.). Thus, it is likely that when gifted individuals pursue
their adolescent interests when seeking a profession, they are more likely to have higher
levels of responsibility, achievement, and satisfaction within their career.

Feldman and Matjasko (2007) and Olszewski-Kubilius and Lee (2004) both found
a propensity for students to participate in multiple types of activities (e.g., sports,
academic clubs, volunteering). Feldman and Matjasko (2007) found that most of the
adolescents they studied participated in at least two different types of activities from the
four groupings of: sports, academic, school, and performance. The students who
participated in multiple activities were mostly upper-middle class females, with high
GPAs. They also found positive correlations between extracurricular activity
participation and both SES and achievement. Felman and Matjasko contend that
increased competition due to school size and an increase in “pay-to-play” programs may
be placing more students at risk of becoming underachievers, because of a lack of access
to activities. Felman and Matjasko, however, did not differentiate gifted and non-gifted
students in their study.
Looking specifically at gifted students, Olszewski-Kubilius and Lee (2004) surveyed the types of activities in which the students are participating. They found that sports, musical performance groups, and academic clubs were all popular with middle and high school gifted students, in that order. When considering participation by talent area, the patterns of student participation generally paralleled their talent area. They discovered consistency between students’ interests and abilities and their selection of extracurricular activities. Further, participating in extracurricular activities, the gifted students extended their knowledge and experience than is available through their basic coursework (Olszewski-Kubilius & Lee, 2004).

The concept that gifted students select activities in accordance with their talent domain is supported by both Achter, Benbow, and Lubinski (1997) and Milgram and Hong (1999). Evaluating the widespread beliefs of multipotentiality in the field of gifted education, Milgram and Hong analyzed the distribution of high-school seniors’ abilities and vocational interests. They found a large proportion of students with differentiated ability and interest profiles, a small proportion of students who had both high abilities and a high level of interests in multiple areas, and a large proportion of high ability students who demonstrated few to no vocational interests. These findings led to the conclusion that most of the students were not multipotential. Although there was a small percentage of students who could have been defined as multipotential, the results indicated that this was the minority and far less than had been previously assumed by other researchers (Emmett & Minor, 1993; Kerr & Ghrist-Priebe, 1988).
Environmental Factors

The environment of individuals, specifically an individual’s school, family, and social environments, can greatly affect their development of talent (Hong & Milgram, 2008a; Flashman, 2012). The Social Cognitive viewpoint (Bandura, 1986; Zimmerman, 1989) details how environmental forces can influence learning. Schools have great influence not only in training talented students how to learn (Coleman, 2002), but also in managing their motivation and expectations (Brady, 2005; Kanevsky & Keighley, 2003). Familial support also benefits talented students (Cho & Campbell, 2011; Hébert, Pagnani, & Hammond, 2009; Reis, Colbert, & Hébert, 2004). Social influences must also be taken into consideration when exploring the environmental influences on students (Emmett & Minor, 1993; Field et al., 1998; Riegle-Crumb, Farkas, & Muller, 2006). The support of mentors has been found to benefit talented students (Ambrose, Allen, & Huntley, 1994; Little, Kearney, & Britner, 2010). The environmental influences represent all external pressures and support that students experience, which in turn affect their learning decisions and development.

The social-cognitive viewpoint of self-regulated learning (SRL) uses Bandura’s (1977, 1986) triadic model of influence (Zimmerman, 1989). The triadic model suggests that self-regulated learning is not solely based on intra-student factors. This perspective links students’ self processes with teachers, other students, parents, and influences within their environment and their behaviors in reaction to these people and influences. A student will not only potentially alter or utilize their environment in order to facilitate learning, but their environment will exert forces that can facilitate or hinder student learning and development. These forces often result in an altered state of motivation. This
holistic conceptualization places SRL strategies within a context of internal and external forces leading to students’ attempts to engage in learning.

School. As school is where the majority of formal academic learning is expected to take place, student achievement can be positively or negatively affected by the school setting. School culture encompasses how the administration, teachers, and students work together, and the stated, or unwritten, codes of conduct that each group is expected to follow. Brady (2005) explored the duality of high school curricula, one based on a formal education, and the other based on the ability to function within the school’s culture. He found that the students’ perception of institutional culture had a limited impact on academic achievement and that social rankings within the peer groups were often based on the student’s level of academic achievement and social skills. Student engagement is often supported when students perceive that they are treated with respect, that there is an equal application of behavioral controls, and that the school encourages all students to learn (Brady, 2005). Without active practices to enhance the students’ feelings of belonging to the school culture, schools will see students with diminished academic achievement and diminished participation in school life.

Looking at supportive school culture, Coleman (2002) centered his research on his premise that the development of talent is nurtured when it takes place in a specialized environment, such as a dedicated boarding school for talented students. His qualitative study illustrated the “shock” of high school juniors who entered into an environment filled with other gifted students. This shock was encountered because the students reported not doing a large amount, if any, of homework at their regular schools, or having it done in class, so they did not need to do it after school. In this new environment,
students were challenged on a daily basis and learning was done in the classroom, not homework. The highly structured nature of the new program and the expectation of student success aided gifted students in getting ready for life outside of high school and for entrance into college. This school maximized its environmental influence by completely saturating the students within a learning environment.

On the other hand, when gifted students’ talents and interests are not supported by their schools they can become “underproducers” (Kanevsky & Keighley, 2003). Underproducers are described as students who have the ability to achieve in an academic setting, but who have made the choice not to. In this qualitative study, the student participants all felt a moral connection to their choice not to participate in school. They felt that if attending school was a requirement, then it should be a requirement for the schools to meet their learning needs. After years of being presented with material that was under their ability, the students made a moral choice that in order to restore equity to the system they were no longer going to participate. This was an attempt to regain some control over their experience. In order to maximize the potential of gifted students, Kanevsky and Keighley (2009) suggest that schools must make an effort to address the five C’s (control, choice, challenge, complexity, and caring teachers) and nurture talented students.

Schools are the seat of learning for most students. Schools must identify methods for addressing all levels of student needs (Brady, 2005; Kanevsky & Keighley, 2003). As the support from schools has such a large impact on the students’ environment, it was included in the current study. School environmental factors are measured in the current study to gage the availability of specialized programs, and the rates at which they were
utilized. Optimally, gifted programs or talent-specific programs are to be available to the participants of all majors.

**Family.** The earliest influences on students invariably come from their families. These influences can provide either positive support or a negative impediment to development (Hong & Milgram, 2008a). Gifted students are more likely to have a supportive family situation than non-gifted students are (Cho & Campbell, 2011), although there may talented individuals who come from dysfunctional families (Reis et al., 2004).

Cho and Campbell (2011) sought to explore some of the differences in family processes in adolescent science-gifted and general education students. The gifted students had a significantly higher level of perceived psychological support than the general education students at each grade level that was tested. In addition, they found that the science-gifted students had a significantly higher level of pressure for intellectual support and monitoring, with increased parental involvement. The authors did not cite a causal relationship between family involvement and giftedness in science, because there could be a possibility that a student’s talents might inspire positive family processes.

The family unit is often examined when studying student environment. However, each family member can influence children differently. An example of this phenomenon was observed by Hébert et al. (2009) while qualitatively examining the relationship between gifted males and their fathers. They found a very strong positive influence within the pairs. While searching for thematic similarities, the authors found six significant topics of fathers’ interaction with their sons. These themes included unconditional belief in son, strong work ethic, encouragement and guidance, maintaining
high expectations and fostering determination, pride in son’s accomplishments, and mutual admiration and respect. Through each of these themes, fathers were able to transfer life lessons and guidance to their sons while remaining supportive and consistent.

Families are the original support system for learners. By providing or withholding support of many different types, family members can influence student learning. As families have been found to have a significant influence on adolescents’ development (Hébert et al., 2009; Cho & Campbell, 2011), the participants in the current study were questioned about the type and amount of support given by their families. This support may have not only affected their academic success but also their choice in academic major.

**Social environment.** In addition to family and school influences, social environments also affect student development. The expectations of others (Emmett & Minor, 1993) and the importance of friends (Field, et al., 1998; Flashman, 2012; Riegle-Crumb et al., 2006) are two examples of the complex systems of social environments that surround students.

Friendships and social situations are very important to the development of talented individuals. Field et al. (1998) found that gifted students rated themselves as being more intimate with friends, assuming fewer family responsibilities, and having average or above average self-esteem, a superior academic self-image, and social skills that are the same or better than non-gifted students. They also viewed themselves as risk-takers more so than their non-gifted counterparts. The gifted students, unlike the non-gifted, gave indications that their friends were more important to them than their families. Field et al. (1998) speculated that the differences may have occurred because of an
advanced level of psychological development in the gifted students. This research warns that it is unwise to underestimate the value of social systems and friendships when studying the development of gifted adolescents.

Addressing the stereotypical absence of females in science and math courses, Riegle-Crumb et al. (2006) contended that the presence of high-achieving female friends in science and math can positively affect the choice of females to enroll in the courses. Females who had female friends with high subject-specific grades were more likely to take advanced courses in all (science, math, and English) areas. These results, however, were not mirrored for the male participants. Citing the potential academic and emotional support that female friends can provide, Riegle-Crumb et al. discuss how the presence of like-gendered friends can foster academic achievement in adolescents, especially for females.

Social environments of general society are also important when gifted individuals are making career decisions. Emmett and Minor’s (1993) research on career making decisions in gifted students not only addresses the factor of interest (as stated above), but also details how talented students are often influenced by other people’s expectations. The factors influencing career choice that was most frequently discussed in interviews with gifted graduates was sensitivity to the expectations of others. The participants in their study spoke of not only the expectations of their families, but also of choosing a career that earns community respect, choosing one that society has found more important than others, choosing a profession that will help other members of the community, or choosing one that will not waste their gifted ability.
The current study details how important the opinions of others are to advanced students. It will be interesting to find whether and how graduate students from different fields view the expectations of other people. As discussed in the studies by Emmet and Minor (1993), Riegle-Crumb et al. (2006), and Field et al. (1998), students’ social environments can have a profound effect on talent development. Friends, teammates, co-workers, and others may have had a large impact on the academic paths that the participants of the current study have followed.

**Mentor.** Within the context of talented students, mentors often serve as a guide into and through a student’s field of study. Mentors can be found both in schools and in external arenas. A student’s interaction with a mentor can completely alter their talent path and life (Little et al., 2010). Creativity can be especially influenced with the help of a mentor (Ambrose et al., 1994).

Within an educational system that deals primarily with mass instruction, mentorships can provide opportunities for students to develop an individualized relationship that can foster guidance, instruction, and encouragement that school districts often cannot provide. In their study, Little et al. (2010) assessed experiences of gifted students who were enrolled in a summer mentoring program, finding that the participants had self-perceptions of growth in their job competence and research skills. Further, gifted students had generally positive relationships with their mentors. Little et al. described approachability and availability as important factors influencing the quality of their relationship. Negative relationships were usually due to a lack of time spent by the mentor with the student. Talented students can utilize mentors to experience and explore what a job in their potential career field might be like.
Mentors can also be an important guide for individuals who demonstrate high levels of creativity (Ambrose et al., 1994). Trust is an important aspect of a successful mentoring relationship; the student relies on the mentor for guidance and trusts the advice that is given. In their case study, Ambrose et al. (1994) explored the mentoring relationship that an artistic youth (Jon) had with his teacher and an expert in artistic communication. Jon detailed his metacognitive and emotional growth and the clarification of his goals through the process of the mentorship. Through the mentorship experience, Jon was able to build and clarify his interests, develop a passion for his work, and receive emotional support that was crucial to his situation. Mentoring is a precious relationship; however, like all good relationships, it must be nurtured in order for a strong bond of trust and respect to grow (Ambrose et al., 1994).

The above studies by Little et al. (2010) and Ambrose et al. (1994) demonstrate the importance mentors, especially with gifted students. The influential nature of mentors, especially during the adolescent years, lends support for including it in the current study.

Summary

Talented individuals have a complex background of many attributes and factors that contribute to the development of their talents. Cognitive ability, personal-psychological attributes, and environmental-social factors are groupings used to explain intricate concepts that work together to determine the level of potential talent for an individual (Hong & Milgram, 2008a). Highlighted within this review of the literature are previous and current findings from each of these factors and how these works informed the current investigation. Differences were often found between talented and non-talented students.
The potential disparities between talented students from different fields, especially students at the graduate level, have yet to be researched. The current study attempts to bring attention to this deficit.
CHAPTER 3

Methodology

This study examined the following questions regarding graduate students who demonstrate potential talent in their discipline:

(a) Do graduate students from three domains differ in their (1) analytical and creative-thinking ability, (2) adolescent motivation attributes, and (3) adolescent environmental backgrounds. This question was tested by a multivariate analysis variance and following univariate analyses of variance.

(b) Do graduate students from three domains differ in subscale scores in (1) creative-thinking ability, (2) adolescent motivation attributes, (3) adolescent environmental backgrounds, and (4) adolescent activities? This question was tested by profile analysis.

These research questions were examined using both quantitative and qualitative data analyses.

Participants

The participants in this study consisted of 38 Master’s level graduate students in three discipline areas at the University of Nevada, Las Vegas — sciences ($n = 12$), arts ($n = 12$), and education ($n = 14$). In this section, participants’ disciplines, selection procedures, and demographic information are provided.

Domains Selected for the Study

**Sciences.** Twelve graduate students from chemistry and physics were selected for this study. They represented individuals with a moderate degree of talent in the science domain. Majors within these two sub-domains were likely to be similar in their
prerequisite and competence requirements to succeed in the area. Biglan (1973) considers chemistry and physics to occupy relatively similar positions on his axis of subject matter. These subjects are classified as hard, pure, and non-life system areas. Both chemistry and physics at the graduate level are highly theoretical and require advanced mathematical and analytical-thinking abilities. These majors are highly research based and require a specific focus of interest (UNLV Department of Chemistry, n.d.; UNLV Department of Physics and Astronomy, n.d.).

Majors from the life sciences were not included, because their prerequisite training and content related skill sets are expected to differ substantially from those of the chemistry and physics majors. Life sciences are considered less grounded in mathematical theory than chemistry and physics majors, and the Master’s program in Life Sciences is “designed to prepare students for a diverse set of science-related careers” (UNLV School of Life Sciences, n.d.).

**Arts.** Twelve graduate students from creative writing and music were selected. The two majors require creative-thinking skills and creative disposition that allow students to not only recreate or appreciate works from established masters in their domains, but also to create new and individualistic works of their own. Creative writing and music are classified as soft, pure, and non-life system areas (Biglan, 1973). The Master’s program in creative writing is based on “the belief that the best writing is done by individuals who know that literature is something created from more than mere self-expression; that great books are written by the few who know their gift is connected to the world they live in” (UNLV English Department, 2009). The Master’s programs in
Majors from the areas of theater and film have not been included, because they are considered to have a significantly different set of skills and aptitudes than the creative writing and music majors. The theater programs are diverse, ranging from directing to stage management, and emphasize practical experience (UNLV Department of Theater, 2010). The film Master’s program focuses on screenwriting and is based on a narrative-driven curriculum (UNLV Department of Film, n.d.). Studio art students were initially recruited for this research. However, this major was eliminated from the arts group because only one student was willing to participate in the study.

**Education.** Fourteen graduate students from the Department of Curriculum and Instruction, specifically teacher education, were selected to represent education in this study. According to Biglan (1973), education is classified into the soft, pure, and life system areas. The central mission of the Master’s programs in the Curriculum and Instruction department is to develop educators grounded in research and sound professional practice (UNLV Department of Curriculum and Instruction, n.d.).

The majors from other social science domains, such as counseling and social work, which are primarily focused on application, are expected to have different skill sets and attributes from the curriculum and instruction majors.

**Participant Selection Procedure**

To ensure that the participants in this study exclude graduate students who exhibit a minimal level of talent in the area they pursue and to select participants for qualitative
data gathering, two levels of selection procedures were adopted—solicitation and interview.

**Solicitation.** In order to select appropriate individuals from each discipline area, one of two selection procedures were used. First, in all departments other than the Department of Curriculum and Instruction, students were recruited by visiting their classes and asking them to volunteer for the study or by having instructors send e-mail solicitations to qualified students within courses that had multiple academic majors represented. Access to potential participants within the Department of Curriculum and Instruction was gained through a faculty member within the department. As there are over 450 (UNLV Office of Institutional Analysis & Planning, 2011) students in this department, it was important to target those students who could be considered at least moderately talented at teaching. Because there are fewer admissions requirements to meet in order to enter into the Department of Curriculum and Instruction (e.g., no standardized tests are required; UNLV Department of Curriculum and Instruction, n.d.), it was important to have assistance by a faculty member for selecting students for this study. The education students that were targeted within this research were members of an elite teaching and service organization that places highly qualified teachers into depressed, urban areas in an effort to bring an equalization of education to students in these areas (Teach for America, 2011b). These students were recommended and chosen because they had already been qualified through this organization as being effective teachers.

**Interviews.** After the completion of the general data gathering sessions (see Data Collection Procedure) students were selected from each discipline to participate in one-on-one structured interviews. Four students from each group were selected. In groups that
were made-up of two majors, two students from each major were selected. Participants for interviews were selected from the pool of contributors who had completed the tests and questionnaires. Graduate students who could be considered typical from each respective field and who would be willing to share their experiences were chosen. Several steps were taken to achieve these conditions. First, the scores of the analytical-thinking ability test (Raven’s Progressive Matrices) were averaged and the standard deviations of the scores were computed for each major. Students who scored beyond one standard deviation within each field were removed from the potential participants list. Next, responses to the open-ended questions in the questionnaire were evaluated. The participants who responded to most open-ended items were considered more forthcoming with their experiences. The students who met these conditions were selected to participate in the interviews. In cases of ties or very similar scores, the researchers’ personal judgment was used to select the final participants for interviews; this is considered prudent since the researcher had impressions about each participant through the first phase data collection. In this manner, 12 students, representing 5 different majors, were selected to participate in the interviews: arts (2 music and 2 creative writing), sciences (2 chemistry and 2 physics), and education (4 curriculum and instruction). Five of the 12 selected opted not to participate in the interview. Thus, the next 5 students who fit the best for the interview were selected. Potential participants were contacted by phone, when a phone number was available, and e-mailed to schedule a time to meet for the interview.
Participant Demographic Information

Of the total 38 participants, 18 were female and 20 were male. Approximately 74% of the participants were between 21 to 25 years old, and 84% of the participants reported completing no more than one year of graduate school.

The 12 science majors consisted of four females and eight males. Nine of them were between the ages of 21 and 25 and three of them were between the ages of 26 and 30. In this group, 66.7% of the students attended high school in the United States. There were eight physics majors and four chemistry majors.

Of the 12 arts majors, five were females and seven were males. Six students were in the 21 to 25 age category, three students in the 26 to 30 age category, two students in the 31 to 35 age category, and one student in the 46+ age category. The arts majors went to high school in the United States 83.3% of the time. There were six music majors and six creative writing majors. The creative writing majors were evenly split between poetry and fiction specialties.

Of the 14 education majors, nine were females and five were males. All but one of the students was in the 21 to 25 year age category. The one older student was in the 26 to 30 year age category. Table 1 presents the summary demographic information for the entire sample of participants.

Of the 12 interview participants, 6 were female and 6 were male. All students, except one, were in the 21 to 25 age category. The one student who was in the 26 to 30 age category was the only interviewee to attend high school in Canada, and who also happened to be the only one interview participant who attended high school outside of the United States. Table 2 presents demographic information for the interviewed students.
Table 1

Demographic Information – Full Sample

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Art ((n = 12))</th>
<th>Science ((n = 12))</th>
<th>Education ((n = 14))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>27.8 (6.90)</td>
<td>24.3 (2.26)</td>
<td>23.4 (1.34)</td>
</tr>
<tr>
<td>Years of Graduate School</td>
<td>1.04 (1.01)</td>
<td>1.33 (1.37)</td>
<td>1.14 (0.54)</td>
</tr>
</tbody>
</table>

Table 2

Demographic Information – Interviewed Students

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Art ((n = 12))</th>
<th>Science ((n = 12))</th>
<th>Education ((n = 14))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>24.3 (2.50)</td>
<td>23.0 (0.00)</td>
<td>23.0 (0.00)</td>
</tr>
<tr>
<td>Years of Graduate School</td>
<td>0.63 (0.48)</td>
<td>0.50 (0.58)</td>
<td>1.00 (0.00)</td>
</tr>
</tbody>
</table>

Instrumentation

Seven instruments were utilized in this research. First, the participants’ current analytical and creative-thinking abilities were measured. Then their self-report measures of motivation, environments, and experiences during their adolescence and interview data were obtained. The seven instruments include the Abbreviated Torrance Test for Adults (ATTA; Goff & Torrance, 2007b), the Raven’s Advanced Progressive Matrices (APM; Raven, Court, & Raven, 1988), the Activities and Accomplishments Inventory: College II (AAI: College II; Hong & Milgram, 2008b), the Self-Assessment Questionnaire: Motivation (SAQ-M; Hartzell & Hong, 2008a), the Self-Assessment Questionnaire:
Social and Environmental (SAQ-SE; Hartzell & Hong, 2008b), the Demographics Questionnaire (DQ), and the Structured Interview Document (SID).

Creative Thinking Ability

The Abbreviated Torrance Test for Adults (ATTA; Goff & Torrance, 2007b) was used to measure creative-thinking ability. Developed as a short form of the Torrance Test of Creative Thinking (TTCT; Torrance, 1974), the ATTA was designed to measure general creative-thinking ability in people over 18 years old. This measure has three components and can be administered in less than 30 minutes. The reported KR21 reliability coefficient of the total ability score is .84 (Goff & Torrance, 2002). The KR21 reliability coefficients for separate ability scores are as follows: .45 for Fluency, .38 Originality, .84 Elaboration, and .38 Flexibility (Goff & Torrance, 2002). Goff and Torrance (2002) indicate that the low reliability estimates were due to the small number of items and claim that the focus on creating a shortened measure was more important than creating a measure with higher reliabilities. As this measure was directly derived from the TTCT, the evidence to support the claim that the ATTA is a valid and reliable instrument is incomplete (as of 2007) as the authors referencing the evidence of the original TTCT for support (Goff & Torrance, 2007a). A recent reliability estimate (Cronbach’s alpha) reported for the ATTA was .72 (Althuizen, Wierenga, & Rossiter, 2010). With the current sample, the Cronbach’s alpha for the overall ATTA was .46.

For the current sample, interrater reliability was computed using the scores by two raters. The agreement rate was .84. For the scores showing discrepancies between the two raters, a forced agreement procedure was used to determine a score. Each rater’s notes on scoring were utilized in this endeavor. Before the two raters scored, they studied scoring
rules in the manual, met to compare their scoring practices, and decided to make notes while scoring each test for future use when the score discrepancies were found between the two raters.

After reviewing the reliability and correlation coefficients on the individual items, the decision was made to separate verbal and non-verbal creative-thinking abilities. As fluency and originality measures were available for both verbal and non-verbal measurements, both fluency and originality scores were included in the analysis. Scores from Activity 3 were not as reliable as those of Activities 1 and 2, thus Activity 3 was not included in this study. Scale scores were then computed to obtain verbal and non-verbal creative-thinking ability scores. The Cronbach’s Alpha for verbal and non-verbal creative-thinking ability scores was .79 and .79, respectively. Almeida, Prieto, Ferrando, et al. (2008) found similar problems with the TTCT, from which the ATTA was derived. When the authors conducted a factor analysis on TTCT scores, the factors loaded on activities, instead of across constructs (i.e. fluency, originality, flexibility, and elaboration). This indicates that using the resultant overall score from the TTCT (and likely from the ATTA) may not give an accurate measure across the constructs.

**Analytical Thinking Ability**

Raven’s Advanced Progressive Matrices (APM; Raven, Court, & Raven, 1988) was used to measure analytical-thinking ability. The APM is a version of the Raven’s Progressive Matrices that has been designed to reliably differentiate among people in the top 25% of the population in the area of analytic reasoning (Bors & Stokes, 1998). The online version of this measure was used. It is designed to administer items with increasing difficulty levels. The items consist of two parts. Part 1 has 23 problems and
was administered with a 40-minute time limit. Part 2 has 2 problems with a 2-minute time limit. The timing of the online test can be stopped and restarted at the students’ discretion.

In Bors and Stokes (1998) evaluation of the APM scores, the internal consistency (Cronbach’s Alpha) was .84 for one set of scores. This is very similar to the internal consistency of .87 reported in the APM manual (Raven, Raven, & Court, 1998). The convergent validity of the APM was measured against the American College Test (ACT; ACT, n.d.) (Koenig, Frey, & Detterman, 2008) and the Scholastic Assessment Test (SAT; College Board, n.d.) (Frey & Detterman, 2004). The correlations were .61 with the ACT and .48 with the SAT, respectively, indicating a moderate relationship. The reliability with the current data set could not be calculated, due to the relative lack of scoring information provided by the online source of the data.

**Interest, Activities, and Accomplishments**

The Activities and Accomplishments Inventory: College II (AAI: College II, Hong & Milgram, 2008b) was used to measure interest, activities, and accomplishments that the participants experienced in their adolescence. The AAI: College II is a self-report instrument that measures participants’ activities and accomplishments in various domains (e.g., science, music, art). Participants rated their level of activities from four alternatives to answer each item. Due to differences in frequency, intensity, and difficulty of activities and accomplishments, several sets of options are used throughout the inventory. The scales include: (a) not at all, once, twice, or three or more times, (b) not at all, sometimes, very often, or almost every day, or (c) never, occasionally, frequently, or weekly and others. There are 13 different domains and each domain includes 9 items, one of which is
open-ended. For example, the open-ended item for the science domain is, "If you participated in any other kinds of science-related activities during high school, please describe these activities."

Examples of activity items in each domain are: "I collected scientific specimens" (science); "I had a solo part in a dance performance" (dance); "I liked to forecast economic growth or shifts" (business); “I composed or conducted music” (music); “Other people called upon me to help them solve their computer problems” (technology and computer); “My artistic work was exhibited publicly” (visual arts); “I drew architectural designs in a group or by myself” (architecture); “I was active in acting in plays or directing plays” (theater and film); “I took part in a mathematics competition” (mathematics); “I was elected to an important leadership position” (social leadership); “I wrote and published creative writings” (creative writing); and “I was on my high school team in a sport” (sports). Added to AAI: College II are the items to measure education-related activities and accomplishments. Examples of education activities are: "I was a teacher’s aid." and "I volunteered as a member of a tutoring organization."

Studies on previous versions of this inventory have provided moderate to strong evidence of the construct validity of AAI (Hong & Milgram, 1996; Hong, Whiston, & Milgram, 1993), including predictive validity from longitudinal studies (Hong, Milgram, & Whiston, 1993; Milgram, Hong, Savit, & Peled, 1997). With the current sample, the Cronbach’s alpha was calculated for each section of the AAI: College II. Their values were: science (α = .87), dance (α = .89), business (α = .66), music (α = .91), technology and computer (α = .85), visual arts (α = .87), architecture (α = .82), theater and film (α =
.88), mathematics ($\alpha = .89$), social leadership ($\alpha = .94$), creative writing ($\alpha = .73$), sports ($\alpha = .89$), and education ($\alpha = .85$).

**Motivational Attributes**

The Self Assessment Questionnaire: Motivation (SAQ-M; Hartzell & Hong, 2008a) was used to examine motivational attributes that might have influenced the participants’ choice to pursue a graduate degree in their selected domain. The SAQ-M consists of five components of motivation with 36 items: goal orientation (8), effort (7), intrinsic and extrinsic motivation (8), interest (7), and self-efficacy (6). In addition, an open-ended item is included to evaluate participants’ thoughts on the most important motivational factors: “What were the three most important reasons why you have chosen to follow your current path of study?” See Appendix A for questionnaire items.

As indicated in the directions on the questionnaire, participants were asked to respond to each item retrospectively, recalling their motivational states during their high school years. Research participants rated themselves on the following four-point scale: (1) Not true at all, (2) Slightly true, (3) Often true, and (4) Very true. The open-ended item allowed participants to explain their perceptions of motivating factors that may not be listed in the Likert-type items.

The overall reliability estimate for the SAQ: M was .89. The subscale score reliability estimates were: mastery goal orientation ($\alpha = .72$), performance goal orientation ($\alpha = .85$), effort ($\alpha = .91$), intrinsic motivation ($\alpha = .51$), extrinsic motivation ($\alpha = .73$), interest ($\alpha = .63$), and self-efficacy ($\alpha = .74$). Considering the small sample size and meaningful content coverage of each subscale, these subscale scores were considered sufficiently reliable for the current study (Schmitt, 1996).
**Goal orientation.** The goal orientation component of the SAQ-M explored participants’ tendencies in orienting their goals during adolescence. The items were adopted from the Instructional Practices Questionnaire II (Hong, Nadelson, & Hartzell, 2005, 2006). An example of goal orientation items with a mastery focus is: “Mastering a concept or technique associated with learning was important to me.” An example of goal orientation items with a performance focus is: “Doing better than my classmates was important to me.”

**Effort.** The effort component measures participants’ perception of their application of effort during adolescence. The items were adopted from a scale used in various studies on self-regulated learning (Hong, O’Neil, & Feldon, 2005; O’Neil, Sugrue, Abedi, Baker, & Golan, 1992). An example of effort items is: “I worked as hard as possible on all tasks.”

**Intrinsic/extrinsic motivation.** Participants’ tendencies to be either intrinsically or extrinsically motivated were examined. The items were adapted from the Intrinsic Goal Orientation and Extrinsic Goal Orientation scales of the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991). An example of motivational items with an intrinsic focus is: “I thought that what I was good at was valuable to society.” An example of items with an extrinsic focus is: “I expected to be paid well after I graduated.”

**Interest.** The interest component measures whether participants chose their specific scholarly area based on their interest. The development of these items were informed by the qualitative study by Emmet and Minor (1993) on the college and career
decisions of gifted young adults. An example of interest items is: “I enjoyed learning about topics that I was good at.”

**Self-efficacy.** Finally, the self-efficacy component measures the participants’ general conceptions of their own competence. Self-efficacy items were modified from the generalized self-efficacy scale by Schwarzer and Jerusalem (1995). An example of self-efficacy items is: “I always managed to solve difficult problems if I tried hard enough.”

**Social-Environmental Factors**

The Self-Assessment Questionnaire: Social and Environmental (SAQ-SE; Hartzell & Hong, 2008b) was used to examine social and environmental attributes that might have influenced the participants’ choice to pursue a graduate degree in their selected domain. The SAQ-SE is composed of 38 items and three open-ended items. All items were based on the participants’ high school experiences. This questionnaire explored how the participants’ school (11 items), family (11), and “other” environments (16) shaped their adolescent development of talent and domain selection. See Appendix B for questionnaire items.

Participants rated themselves on each item from the following four-point scale: (1) Very unlike my experience, (2) Rather unlike my experience, (3) Somewhat like my experience, and (4) Much like my experience. The open-ended item at the end of each section allowed participants to explain their perceptions of how school, family, and friends each affected the development of their interests and talents. The three qualitative items from the SAQ-SE are: "What else did your school do to help you develop your interests and talents?"; "What else did your family do to help you develop your interests and talents?"; and "What else did your friends do to help you develop your interests and
talents?" These questions were included to ensure that participants reported all experiences that might have contributed to the development of their interests and talents.

The reliability estimate (Cronbach’s alpha) of the SAQ: SE scores was .86. The subscale scores’ reliability estimates were: School (.85), Family (.73), and Other (.74).

**School.** The school component includes teachers and other mentors and school administrative structures that the participants thought helped or hindered their learning. The items were adapted from the School Effectiveness Questionnaire (Baldwin, Coney, Fardig, & Thomas, 1993). An example of a school item is: “When I was in high school…there were teachers that I remember helping and encouraging me.”

**Family.** Participants’ family dynamics, the presence of gifted individuals in their home-life, and the career-oriented pressures placed on the participants by their families were measured by the family component of this questionnaire. The development of these items was informed by the Parent/Family Involvement Index (Cone, Delayer, & Wolfe, 1985). An example of family items is: “When I was in high school…my parents disagreed with my choice to pursue my interests.”

**Other environmental influences.** Relationships with peers and others that had a significant impact on the formation of the interest in the domain were explored. These items also explored participants’ perceived relationship with the general public in terms of either the intellectual or the social realm. These items were developed after reviewing Barber and Torney-Purta’s (2008) “The relation of high-achieving adolescents’ social perceptions and motivation to teacher’s nominations for advanced programs.” An example of other environmental items is: “When I was in high school…being academically talented was considered a good thing in my neighborhood.”
Demographics

The Demographics Questionnaire (DQ) acquired basic demographic information about the participants. Information such as scholarly domain, age, and scholarly background and achievements were gathered. See Appendix C for questionnaire items.

Structured Interviews

A 19-item Structured Interview Document (SID) was created to use during the follow-up interviews. Items on this document mirrored the topics posed within the questionnaires given in the general data gathering sessions. This allowed more in-depth data to be gathered on the same topics. An example of an item is: “Did you think that you were creative during high school?” See Appendix D for document items.

Procedures

Pilot Testing of Instruments

The two self-assessment questionnaires (Motivation and Social-Environmental) and the education component of AAI: College II were piloted on participants representing similar characteristics to the target sample of the main research study. The pilot testing included one-on-one testing with one or two students from each sub-domain: chemistry (2), physics (2), education (2), creative writing (2), and music (1). As music students from UNLV were unavailable for the pilot, the questionnaires were administered remotely to a master’s level music student from the University of Oregon. Art students were not available for the pilot testing, so they were excluded from this initial round of testing. To obtain a pilot sample, the Graduate Coordinator for each department or a designated professor was contacted. Participants who would be appropriate for the pilot testing were described to these individuals.
The participants completed the questionnaires using the same procedure that was applied in the main data collection period. The time for questionnaire completion was gathered. Second, respondents’ comments on item meanings and connotations and item clarity were collected. Whether one data-collection session would be sufficient was explored.

Based on the pilot findings, the questionnaires were modified. Some of the participants mentioned that it was somewhat difficult to remember back to high school. To respond to these comments and to counteract this impediment a sentence was added in the verbal instructions, “...some of the items will ask you to remember back to high school. I understand that it may be difficult to remember back that far, but please try your best to remember and respond to the items.”

Repetitious questions posed a problem for some of the pilot participants. To alleviate this problem, verbal instructions were added to the questionnaire, “While progressing through the items you may notice that some of the questions seem quite similar. Please don't be concerned about similarity but just answer all items.” These instructions present the idea that some of the questions would seem quite similar, but that the participants should answer each one as a separate and unrelated question. This should reduce the students’ adverse reactions to the similar questions within the questionnaires.

There were some items on the Self-Assessment Questionnaire: Social and Environmental (SAQ-SE) (Hartzell & Hong, 2008b) that needed to be removed, altered, or added. An item: “I participated in my school’s Gifted and Talented program” was removed because it became evident that most high schools do not offer Gifted and Talented programs. One item was altered from “I was enrolled in advanced classes in
subjects where I was talented” to “I was enrolled in advanced placement (AP) classes in subjects where I was talented.” This change was prompted by confusion by the participants as to whether the question was asking about AP classes, honors classes, or some other form of non-standard course. Finally, in order to clarify the differences between participants who did not take either AP or honors classes because they were not offered in high school and those who did not take them because they did not want to or were not qualified to, two items were added. These items read: “I had the opportunity to be enrolled in AP classes” and “I had the opportunity to be enrolled in honors classes.”

The Education portion of the AAI that was pilot tested included 15 items. From the 15 original items, 8 items were selected based on participants’ comments and scores from the pilot testing. One open-ended item was developed that matches the other open-ended items in the AAI: College II. The Education section was inserted into the full AAI version.

Data Collection Procedure

Questionnaire data collection. The permission to conduct this study was approved by the University of Nevada, Las Vegas Office for the Protection of Research Subjects, following the protocol directed by the Internal Review Board.

Data collection began during the Fall 2009 semester and continued through the Spring 2010 semester. General testing sessions were set up on various days of the week at various times. Participants were able to choose the session that best fits their individual schedules. General testing sessions were held in classrooms in the College of Education building at UNLV. Participants who could not attend a general testing session were offered individual sessions that followed the exact same procedures.
Because both the analytical-thinking measure and the creative-thinking measure are both intellectually challenging and time consuming, administering these tests in two different sessions was deemed optimal. The APM was administered online by Pearson (the testing service that markets the APM), before the participants attended the general testing session. The participants were able to take the APM when it was convenient for them, but they were requested to complete it in one sitting.

At the testing session, participants were first given the Abbreviated Torrance Test for Adults, then the Activities and Accomplishments Inventory: College II, next the Self-Assessment Questionnaire: Motivation, followed by the Self-Assessment Questionnaire: Social and Environmental, and finally they completed the Demographics Questionnaire. The research purpose was described to the participants and the ATTA was passed out. Instructions for the ATTA were read to the participants. Details of the testing procedure are presented in Appendix E. When they were finished with the first questionnaire (ATTA), they were offered a break. However, they were requested to complete the rest of the questionnaire packet (SAQ-M, SAQ-SE, AAI: College II, and Demographics Questionnaire) without a break in between them. There was not a time limit on these questionnaires.

**Interviews.** The permission to conduct this portion of the study was approved by the University of Nevada, Las Vegas Office for the Protection of Research Subjects, following the protocol directed by the Internal Review Board.

Data collection began during the Spring 2010 semester. Interviews were conducted either in a private office in the College of Education Building on the UNLV
campus or in a private study room at the Clark County Centennial Hills Library. These sessions were scheduled at the convenience of the participants.

A much more detailed research purpose was explained to the participants and they were informed that their responses would be recorded, but kept confidential. Each item on the Structured Interview Document (SID) was posed to the participants, with clarification being given or asked for, if needed. There was no time limit imposed on these interviews.

**Data Analysis**

This study utilized both quantitative and qualitative methods to evaluate the influences that personal attributes and backgrounds have on graduate students’ domain selection and talent development.

**Qualitative data analysis.** Participants’ responses to the open-ended questions in the three self-assessment questionnaires (SAQ-M, SAQ-SE, and AAI: College II) and the interviews were analyzed using Marshall and Rossman's (1999) six phases of qualitative data analysis method. First, the data was entered in a computer file. Second, categories, themes, and patterns that the data represent were generated that coincide with the topic of the research project. Third, the data was then coded according to the previously determined categories and themes. Fourth, after the data has been coded, the emergent understandings of the topic were examined by checking them within the entire data. Fifth, alternative explanations were explored in order to determine the best set of explanations.

Completed questionnaires and interviews were separated by discipline. After categories and subcategories were elicited, narrative data were mapped onto the elicited subcategories. Then elicited categories and subcategories were tallied by individual and
disciplines to produce numerical information. This information from the category elicitation was used to examine whether a pattern of developmental resources emerge in each domain along with narrative examples.

Interviews and questionnaire responses were analyzed using similar methods. The data from the questionnaires were analyzed separately from the interview data.

**Quantitative data analysis.** Recoding took place for reversed items. Data were screened for input errors and outliers, and statistical assumptions were examined. Reliability estimates were obtained for each scale and subscale.

Descriptive statistics and correlations were computed, and the pattern of correlations was examined (e.g., correlations among the components of motivation). To determine if there were any domain differences in the combined dependent variables (Raven, ATTA, Average Motivation and Social/Environment scores), a multivariate analysis of variance was conducted, followed by univariate analysis for each dependent measure. For the measures with subscales, profile analyses were conducted for each scale (e.g., motivation) to examine the pattern of subscale scores within each scale. As the sample size is rather small, the Pillai’s trace was used to protect against Type I errors. The between-subject variable was the domain (3 groups) and the within-subject variable was the measure (e.g., motivation subscale scores). When there was an interaction effect between the domain and the within-subject variable, simple effects were tested, instead of main effects.

In addition to computing statistical significance, effect size was computed. Whereas the statistical significance measures the reliability that there is a relationship between the variables, effect size measures how much of a relationship there is
(Tabachnick & Fidell, 2007). The eta-squared, or partial eta-squared, was used for reporting effect sizes that come with MANOVAs, ANOVAs, and main and interaction effects of the profile analyses. Hedges’s $g$ was measured for the pairwise comparisons of the ANOVAs and the simple effects with profile analyses.

**Assumption testing.** Assumptions for each statistical test were examined for each group, except for the homogeneity of variance/covariance matrices that compares group behaviors.

**ATTA: Verbal.** The statistical assumptions were met satisfactorily for the analysis of ATTA-verbal data. The art majors had neither univariate outliers nor multivariate outliers (Mahalanobis Distance for the multivariate outliers: $\chi^2_{cv} = 13.82$, maximum observed $\chi^2_{obs} = 5.22$) on fluency and originality. Univariate normality assumption was largely met. Mardia’s normalized estimate was -0.61, indicating multivariate normality.

Neither science nor education data had outliers (both univariate and multivariate). Normality assumptions (both univariate and multivariate) assumptions were met in the science and education data, with Mardia’s normalized estimates, -0.47 and -0.46, respectively. There was no collinearity; none of the variance inflation factors (VIF) were above ten.

The assumption of homogeneity of variance-covariance matrices (Box’s M = 5.04, $p = .59$) was met, as were the univariate assumptions of homogeneity of error variance for both the fluency (Levene’s $F = 0.62, p = .54$) and originality (Levene’s $F = 2.91, p = .07$) scales.

**ATTA: Non-verbal.** Although the assumption tests showed several minor areas of concern, the majority of the data supported the assumptions. The art and education
majors had no univariate outliers, and the science majors had one univariate outlier ($z = 3.17$) on the fluency scale; this subject was not a multivariate outlier. This data point was retained; this participant had a score of 3 while other Science majors had a value of 2.

None of the majors had multivariate outliers.

Assumptions for multivariate normality were supported for all majors. Mardia’s normalized estimates were 0.90 (art), 1.61 (science), and -1.01 (education). Univariate normality assumption for the fluency data in the science data were positively skewed (3.46). With no multivariate outlier and given the item characteristics, the data were retained. No collinearity was indicated in any of the groups.

The multivariate assumption of homogeneity of variance-covariance matrices (Box’s $M = 25.187, p = .001$) was barely met ($\alpha = .001$ for Box’s M test; Tabachnick & Fidell, 2007). The univariate assumptions of homogeneity of error variance for fluency (Levene’s $F = 4.99, p = .01$) was not met, requiring careful interpretation of the results. The univariate assumption of homogeneity of variance for originality (Levene’s $F = 1.32, p = .28$) was met.

**SAQ-M.** None of the majors had any univariate or multivariate outliers. The assumptions of univariate and multivariate normality were upheld for the art, science, and education majors. Mardia’s normalized estimates were -1.45, -1.50, and -1.50, respectively.

Although some collinearity indices were slightly larger than 10 in two groups, VIF ranging from 1.26 to 12.52 in art, from 1.69 to 17.08 in science, and from 1.31 to 7.92 in education, because these are repeated measures on subscales of the motivation scale within each group, high correlations among subscales were expected, thus
indicating not a serious threat. In addition, as none of the previously stated relationships had correlations at or above .90, and the small sample sizes may have caused artificially higher VIF scores (O’Brien, 2007), all of the factors were kept in the analysis.

The multivariate assumption of homogeneity of variance-covariance matrices (Box’s M = 122.531, p = .007) was met. The univariate assumptions of homogeneity of error variance for mastery goals (Levene’s F = 0.38, p = .68), Effort (Levene’s F = 0.17, p = .84), extrinsic motivation (Levene’s F = 0.37, p = .69), interest (Levene’s F = 2.43, p = .10), and self-efficacy (Levene’s F = 1.35, p = .27) factors were also met. However, the univariate assumptions of homogeneity of error variance for performance goals (Levene’s F = 7.39, p = .002) and intrinsic motivation (Levene’s F = 3.58, p = .04) were not supported. Sample sizes of the three groups were similar (12, 12, 14), thus posing little problem.

**SAQ-SE.** The environmental questionnaire data generally upheld the statistical assumptions. There were no univariate or multivariate outliers for any of the majors. The assumptions of univariate and multivariate normality were also supported for the each of the majors, with Mardia’s normalized estimate ranging from -0.11 to -1.34. None of the groups’ data demonstrated collinearity.

The multivariate assumption of homogeneity of variance-covariance matrices (Box’s M = 16.46, p = .278) was met. The univariate assumptions of homogeneity of error variance for family (Levene’s F = 2.25, p = .12), home (Levene’s F = 0.31, p = .73), and social (Levene’s F = 0.62, p = .54) factors were also met.

**AAI: College II.** For this questionnaire, participants respond to only those items that represent activities and accomplishments during adolescence. As can be expected,
most participants did not participate in activities in all domains, but only in those that they are interested. Thus, although the scores are quantified by averaging those items participants marked (Likert scale), the regular normality assumption testing does not apply to this questionnaire data, where many items in many domains are left untouched by participants. For example, science majors were not likely engaged in architecture activities. Regarding the assumption of homogeneity of error variances, except for the dance ($p = .04$) and theater ($p = .01$) that showed a slight departure from homogeneity, requiring careful interpretation of results, other activity domains met this assumption.

**APM.** No outliers were found for this dataset in any of the majors. Within each of the majors the scores were found to be normally distributed and the overall assumption of homogeneity of error variance was met ($p = .84$).
CHAPTER 4

Results

First, descriptive statistics and correlation coefficients are presented for subscale scores. Second, results of quantitative and qualitative analyses are reported for each research question.

Descriptive Statistics

For each major, overall means and standard deviations are presented for analytical-thinking ability (the Raven’s Advanced Progressive Matrices; APM), creative-thinking ability – verbal and non-verbal (Abbreviated Torrance Test for Adults; ATTA), motivational attributes (Self Assessment Questionnaire: Motivation; SAQ-M), and environmental factors (Self Assessment Questionnaire: Social and Environmental; SAQ-SE) in Table 3. Science majors had the highest mean scores in analytical-thinking ability and non-verbal creative-thinking ability and education majors had the highest mean scores in verbal creative-thinking ability, motivational attributes, and environmental factors. Statistical significance tests are presented below. The mean and standard deviation for the analytical-thinking ability measure represent the number of correct non-verbal associations made by the participant. The original scores could range between zero and 23. For verbal and non-verbal scales of the creative-thinking ability, a factor score was calculated. Verbal scales consisted of counts of total written responses and counts of written responses given to an item that were considered original. Non-verbal scales were counts of total pictorial responses and counts of original pictorial responses that were drawn to complete an item. The factor score had a mean of zero and a standard deviation of 1. Both the Motivation scale and the Environment scale were based on a Likert style
measure where “1” was the option least like the participants’ experiences and “4” was the option most like their experiences.

Table 3

Means and Standard Deviations of Developmental Factors by Three Majors

<table>
<thead>
<tr>
<th>Test</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical-thinking ability</td>
<td>11.08 (4.66)</td>
<td>14.33 (4.12)</td>
<td>12.50 (4.85)</td>
</tr>
<tr>
<td>Creative-thinking ability: Verbal</td>
<td>0.02 (0.87)</td>
<td>-0.39 (0.76)</td>
<td>0.32 (1.21)</td>
</tr>
<tr>
<td>Creative-thinking ability: Non-verbal</td>
<td>-0.18 (1.21)</td>
<td>0.22 (0.31)</td>
<td>-0.03 (1.20)</td>
</tr>
<tr>
<td>Motivation</td>
<td>2.74 (0.41)</td>
<td>2.93 (0.45)</td>
<td>3.10 (0.33)</td>
</tr>
<tr>
<td>Environment</td>
<td>3.00 (0.35)</td>
<td>2.98 (0.42)</td>
<td>3.24 (0.33)</td>
</tr>
</tbody>
</table>

The subscale score means and standard deviations are presented for the students’ activities during adolescence in Table 4. Eye inspections revealed that art majors seemed to have higher music and theater scores, the science majors had higher mathematics scores, and the education majors had higher social leadership, sports, and educational activities scores than scores of the other two corresponding majors.

The subscale score means and standard deviations for adolescence motivational attributes are presented in Table 5. The education majors had higher average motivation subscale scores on all of the subscales but extrinsic motivation, and the art majors had the lower average scores except for interest and self-efficacy, as compared to the average scores of the other two corresponding majors.
Table 4

*Means and Standard Deviations for Activities Subscales by Three Majors*

<table>
<thead>
<tr>
<th>Subscales</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Visual arts</td>
<td>0.94 (0.76)</td>
<td>0.36 (0.52)</td>
<td>0.95 (0.82)</td>
</tr>
<tr>
<td>Sports</td>
<td>0.44 (0.75)</td>
<td>0.42 (0.56)</td>
<td>1.00 (0.95)</td>
</tr>
<tr>
<td>Educational activities</td>
<td>0.89 (0.85)</td>
<td>0.99 (0.78)</td>
<td>1.29 (0.87)</td>
</tr>
<tr>
<td>Science</td>
<td>0.59 (0.73)</td>
<td>0.82 (0.65)</td>
<td>0.88 (0.96)</td>
</tr>
<tr>
<td>Dance</td>
<td>0.55 (0.82)</td>
<td>0.22 (0.49)</td>
<td>0.36 (0.74)</td>
</tr>
<tr>
<td>Business</td>
<td>0.38 (0.51)</td>
<td>0.22 (0.38)</td>
<td>0.29 (0.44)</td>
</tr>
<tr>
<td>Music</td>
<td>1.63 (1.01)</td>
<td>0.93 (0.69)</td>
<td>0.75 (1.00)</td>
</tr>
<tr>
<td>Technology and computer</td>
<td>0.42 (0.51)</td>
<td>0.69 (0.75)</td>
<td>0.72 (0.69)</td>
</tr>
<tr>
<td>Architecture</td>
<td>0.18 (0.34)</td>
<td>0.09 (0.33)</td>
<td>0.23 (0.47)</td>
</tr>
<tr>
<td>Theater and film</td>
<td>1.13 (0.86)</td>
<td>0.23 (0.37)</td>
<td>0.25 (0.34)</td>
</tr>
<tr>
<td>Mathematics</td>
<td>0.22 (0.39)</td>
<td>1.31 (0.82)</td>
<td>0.80 (0.60)</td>
</tr>
<tr>
<td>Social leadership</td>
<td>0.57 (0.87)</td>
<td>0.74 (0.79)</td>
<td>1.91 (1.07)</td>
</tr>
<tr>
<td>Creative writing</td>
<td>0.77 (0.63)</td>
<td>0.64 (0.56)</td>
<td>0.74 (0.61)</td>
</tr>
</tbody>
</table>

Table 5

*Means and Standard Deviations for Motivational Attribute Subscales by Three Majors*

<table>
<thead>
<tr>
<th>Subscales</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M (SD)</td>
<td>M (SD)</td>
<td>M (SD)</td>
</tr>
<tr>
<td>Mastery goals</td>
<td>2.58 (0.68)</td>
<td>2.69 (0.54)</td>
<td>2.86 (0.73)</td>
</tr>
<tr>
<td>Performance goals</td>
<td>2.81 (0.86)</td>
<td>3.04 (0.79)</td>
<td>3.48 (0.36)</td>
</tr>
<tr>
<td>Effort</td>
<td>2.64 (0.69)</td>
<td>2.94 (0.72)</td>
<td>3.26 (0.67)</td>
</tr>
<tr>
<td>Intrinsic motivation</td>
<td>3.17 (0.66)</td>
<td>3.24 (0.45)</td>
<td>3.59 (0.36)</td>
</tr>
<tr>
<td>Extrinsic motivation</td>
<td>2.19 (0.66)</td>
<td>2.88 (0.57)</td>
<td>2.73 (0.72)</td>
</tr>
<tr>
<td>Interest</td>
<td>2.71 (0.67)</td>
<td>2.67 (0.45)</td>
<td>2.73 (0.72)</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>3.08 (0.60)</td>
<td>3.07 (0.60)</td>
<td>3.26 (0.43)</td>
</tr>
</tbody>
</table>

The means and standard deviations for the environment subscales are presented in Table 6. The education majors had slightly higher average scores for all three of the environmental scores when compared to the other two majors. Statistical significance tests are provided below.
Table 6

*Means and Standard Deviations for Environmental Factor Subscales by Three Majors*

<table>
<thead>
<tr>
<th>Subscales</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>2.83 (0.71)</td>
<td>2.92 (0.61)</td>
<td>3.30 (0.44)</td>
</tr>
<tr>
<td>Family</td>
<td>3.10 (0.47)</td>
<td>3.08 (0.55)</td>
<td>3.25 (0.47)</td>
</tr>
<tr>
<td>Social</td>
<td>3.06 (0.28)</td>
<td>2.93 (0.43)</td>
<td>3.16 (0.44)</td>
</tr>
</tbody>
</table>

The mean scores and standard deviations for the creative-thinking ability subscales for both verbal tests and non-verbal tests are displayed in Table 7. When observing the average scores in Table 7, the average non-verbal fluency scores were similar across majors. The education majors had a higher average score for the scale of verbal originality when all three majors were compared and the art majors had a lower non-verbal originality average score. The science majors had the lowest scores for verbal fluency and originality. Statistical significance tests are provided below.

Table 7

*Means and Standard Deviations for Creative-Thinking Ability Subscales by Three Majors*

<table>
<thead>
<tr>
<th>Subscales</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Fluency</td>
<td>7.08 (2.68)</td>
<td>5.67 (2.27)</td>
<td>6.93 (2.99)</td>
</tr>
<tr>
<td>Verbal Originality</td>
<td>2.58 (1.44)</td>
<td>2.17 (1.47)</td>
<td>3.71 (2.27)</td>
</tr>
<tr>
<td>Non-verbal Fluency</td>
<td>1.92 (1.00)</td>
<td>2.08 (0.29)</td>
<td>1.93 (1.21)</td>
</tr>
<tr>
<td>Non-verbal Originality</td>
<td>0.83 (1.19)</td>
<td>1.33 (0.49)</td>
<td>1.07 (0.92)</td>
</tr>
</tbody>
</table>
Correlations

The Pearson product-moment correlation coefficients were examined for the relationships within and between the scale- and the subscale- scores of the tests and questionnaires, within each major. The correlations among average scores of analytical-thinking ability, verbal and non-verbal creative-thinking ability, motivational attributes, and environmental factors (Table 8) demonstrated several strong significant relationships. The strongest was between motivation and environment, $r(12) = .665$, $p = .02$ for the science majors. Other strong relationships were seen between analytical-thinking ability and verbal creative-thinking ability, $r(12) = .614$, $p = .03$, for the science majors, and between non-verbal creative-thinking ability and environment, $r(14) = .582$, $p = .03$, and verbal creative-thinking ability and motivation, $r(14) = .544$, $p = .05$, for education majors. Other relationships were small to medium, ranging from -.10 to .44, except for the trivial relationships that ranged from -.02 to -.07. There were a few negative correlations. For the art majors, motivation scores were negatively correlated with both analytical and verbal creative-thinking scores. Negative relationships between verbal creative-thinking ability and both motivation and environment were demonstrated by the science majors. For the education majors, negative relationships were found between analytical thinking and both verbal and non-verbal creative-thinking ability and between non-verbal creative-thinking ability and motivation.
Table 8

*Intercorrelations Among Developmental Factors by Three Majors*

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Analytical-thinking ability</th>
<th>CTA: verbal</th>
<th>CTA: non-verbal</th>
<th>Motivation</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytical-thinking ability</td>
<td>Art</td>
<td>--</td>
<td>.23</td>
<td>.11</td>
<td>-.02</td>
</tr>
<tr>
<td></td>
<td>Science</td>
<td>--</td>
<td>.44</td>
<td>.61*</td>
<td>.18</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>--</td>
<td>-.08</td>
<td>-.25</td>
<td>.18</td>
</tr>
<tr>
<td>Verbal creative-thinking ability</td>
<td>Art</td>
<td>--</td>
<td>.32</td>
<td>-.46</td>
<td>.27</td>
</tr>
<tr>
<td></td>
<td>Science</td>
<td>--</td>
<td>.18</td>
<td>-.19</td>
<td>-.08</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>--</td>
<td>.08</td>
<td>.22</td>
<td>.59*</td>
</tr>
<tr>
<td>Non-verbal creative-thinking ability</td>
<td>Art</td>
<td>--</td>
<td>.25</td>
<td></td>
<td>.34</td>
</tr>
<tr>
<td></td>
<td>Science</td>
<td>--</td>
<td>.16</td>
<td></td>
<td>.19</td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>--</td>
<td>-.54*</td>
<td></td>
<td>.14</td>
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<tr>
<td>Motivation</td>
<td>Art</td>
<td>--</td>
<td>.37</td>
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<tr>
<td></td>
<td>Science</td>
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<td>.67*</td>
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<td></td>
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<td></td>
<td>Education</td>
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<td>.37</td>
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<td></td>
</tr>
<tr>
<td>Environment</td>
<td>Art</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Science</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Education</td>
<td>--</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*Note. |r| values > 0.30 are in boldface. CTA = Creative-thinking ability.  
* p < .05.*

Next the AAI: College II subscales were analyzed (Table 9). Ninety-six of the 234 correlations were found to have a correlation coefficient of at least .30 across majors. For the art majors, the strongest relationship was between science and architecture activity domains, \( r(12) = .819, p = .001 \). Other statistically significant correlations for the art
majors were large in size, ranging from .78 to .64, with the coefficient between music and writing showing a moderate negative relationship, \( r = .63 \). The science majors’ strongest relationship was between business and theater, \( r(12) = .820, p = .001 \). Other statistically significant correlations for the science majors were relatively large in size, ranging from .69 to .60. The education majors’ strongest relationship was between theater and education, \( r(14) = .665, p = .009 \). The other statistically significant correlations for the education majors were large to medium in size, ranging from .66 to .60, with the coefficient between sports and writing showing a moderate negative relationship, \( r = -.54 \).

Across the majors, the highest correlations were often demonstrated either between two activities that the students participated in, or between those topics that the students did not participate in. Relationships for the art majors, that demonstrated participation in both areas, included music and creative writing, \( r(12) = .63 \), and theater and creative writing, \( r(12) = .48 \). The relationships for the science majors included music and social leadership, \( r(12) = .48 \), and music and educational activities, \( r(12) = .36 \). The education majors demonstrated strong relationships between social leadership and educational activities, \( r(14) = .66 \), and between social leadership and mathematics, \( r(14) = .62 \). The correlation pattern of non-participation was demonstrated in the art majors, science and architecture, \( r(12) = .82 \), architecture and social leadership, \( r(12) = .76 \), and mathematics and technology and computers, \( r(12) = .57 \). For science majors non-participation resulted in high correlations between business and architecture, \( r(12) = .82 \), writing and visual arts, \( r(12) = .69 \), and dance and theater, \( r(12) = .60 \). Finally, business and architecture, \( r(14) = .57 \) and business and theater, \( r(14) = .56 \), in the education
majors. The weakest relationships included that between dance and music, \( r(12) = .00 \), for the art majors, between social leadership and both business, \( r(12) = .00 \) and technology and computer, \( r(12) = .00 \), for the science majors, and, for the education majors, between science and creative writing, \( r(14) = .00 \), and technology and computers and mathematics \( r(14) = .00 \).

Many of the motivation subscale score correlations were found to be significant at varying levels. The strongest relationship was found between performance goals and effort, as all three majors demonstrated a very large and significant correlation; the art majors, \( r(12) = .85, p < .001 \), the science majors, \( r(12) = .82, p = .001 \), and the education majors, \( r(14) = .82, p < .001 \). Other correlation coefficients larger than .60 were as follows (see Table 10): the art majors had a relationship between effort and self-efficacy, the science majors had relationships between effort and extrinsic motivation, interest and effort, interest and performance goals, interest and intrinsic motivation, and extrinsic motivation and self-efficacy, and the education majors had a relationship between intrinsic motivation and self-efficacy. All together there were 36 practically significant correlations, representing just over half of the relationships.

The correlations for the environment subscales showed that only the relationship between the school and social subscales for the science majors was strong and statistically significant, \( r(12) = .78, p = .003 \). The other moderate relationships were between school and family for the education majors and between family and social for the science majors (see Table 11).
Table 9

Intercorrelations Among Adolescent Activity (AAI: College II) Subscales by Three Majors

<table>
<thead>
<tr>
<th>Subscale</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>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Science</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Art</td>
<td>--</td>
<td>.09</td>
<td>.35</td>
<td>-.09</td>
<td>.14</td>
<td>.82*</td>
<td>.47</td>
<td>.26</td>
<td>.72*</td>
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Note. $|r|$ values > 0.30 are in boldface.

* $p < .05$, **$p < .01$. 

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Table 10

*Intercorrelations Among Motivational Attributes Subscales by Three Majors*

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<td>7. Self-efficacy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art</td>
<td></td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td></td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* |$r$| values > 0.30 are in boldface.

* $p < .05$. ** $p < .01$. *** $p < .001$. 

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Table 11

*Intercorrelations Among Environmental Factor Subscales by Three Majors*

<table>
<thead>
<tr>
<th>Subscales</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. School</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art</td>
<td>--</td>
<td>.16</td>
<td>.27</td>
</tr>
<tr>
<td>Science</td>
<td>--</td>
<td>.15</td>
<td><strong>.78</strong></td>
</tr>
<tr>
<td>Education</td>
<td>--</td>
<td>.49</td>
<td>.22</td>
</tr>
<tr>
<td>2. Family</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art</td>
<td>--</td>
<td>.27</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>--</td>
<td>.47</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>--</td>
<td>.10</td>
<td></td>
</tr>
<tr>
<td>3. Social</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>--</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* $|r|$ values $>0.30$ are in boldface.

**$p < .01.$

Finally, the subscales of both verbal and non-verbal creative-thinking ability, verbal fluency and originality and non-verbal fluency and originality, were analyzed (see Table 12). Large significant correlations were found between the verbal fluency and the verbal originality subscales for the art majors, $r(12) = .65, p = .02,$ and the education majors, $r(14) = .85, p < .001,$ and the non-verbal fluency and non-verbal originality subscales for the art majors, $r(12) = .68, p = .02,$ and the education majors, $r(14) = .77, p = .001.$ The medium strength correlations included the relationship between verbal fluency and verbal originality, $r(12) = .48, p = .11,$ for the science majors, between verbal originality and non-verbal fluency, $r(12) = .54, p = .07,$ for the art majors, and between verbal originality and non-verbal originality, $r(12) = .42, p = .18,$ for the science majors. The other correlations were small to very small, ranging from .27 to .03. There were
several small negative relationships between the verbal and non-verbal subscales that ranged from -.25 to -.06, across the science and education majors.

Table 12

*Intercorrelations Among Creative-Thinking Ability Subscores by Three Majors*

<table>
<thead>
<tr>
<th>Subscales</th>
<th>Verbal fluency</th>
<th>Verbal originality</th>
<th>Non-verbal fluency</th>
<th>Non-verbal originality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal fluency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art</td>
<td>--</td>
<td>.65*</td>
<td>.14</td>
<td>.18</td>
</tr>
<tr>
<td>Science</td>
<td>--</td>
<td>.48</td>
<td>.05</td>
<td>.03</td>
</tr>
<tr>
<td>Education</td>
<td>--</td>
<td>.85***</td>
<td>.25</td>
<td>.20</td>
</tr>
<tr>
<td>Verbal originality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art</td>
<td>--</td>
<td>.54</td>
<td>.27</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>--</td>
<td>-.25</td>
<td>.42</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>--</td>
<td>-.09</td>
<td>-.06</td>
<td></td>
</tr>
<tr>
<td>Non-verbal fluency</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art</td>
<td>--</td>
<td></td>
<td>.68*</td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>--</td>
<td></td>
<td>-.21</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>--</td>
<td></td>
<td>.77**</td>
<td></td>
</tr>
<tr>
<td>Non-verbal originality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. |r| values > 0.30 are in boldface.
*p < .05. **p < .01. ***p < .001.*

In the section that follows, results are organized for each research question.
Research Question 1

Do graduate students from three domains differ in their (1) analytical and creative-thinking ability, (2) adolescent motivation attributes, and (3) adolescent environmental backgrounds? This question was tested by a multivariate analysis of variance and follow-up univariate analyses of variance.

Multivariate analysis. The five dependent variables were analytical-thinking ability, verbal and non-verbal creative-thinking ability, motivation, and environment. The independent variable was graduate school major (domain). The three majors did not differ on the combined dependent variables, $F(10, 64) = 1.17, p = 0.33$. Pillai’s Trace was used due to the small sample size. The relatively large effect size, $\eta_p^2 = 0.15$, indicates that the domain difference was practically significant. Although conventional criterion for magnitude of effect size has not been provided for the partial eta squared, the eta-square of .154 is considered large (Cohen, 1988) and computation of eta-squared results is a larger number than that of partial eta squared in multivariate statistics (Tabachnik & Fidell, 2007). With the practical significance found in the multivariate analysis, follow-up univariate analyses were conducted to determine whether the three majors were different in each scale score.

Univariate analysis. For each dependent measure, univariate results were reported along with qualitative findings from the questionnaires and interview data.

Analytical-thinking ability. As expected, no statistically significant group difference was found in analytical-thinking ability scores (measured by Raven’s APM), $F(2, 35) = 1.53, p = .23$. The effect size, $\eta^2 = 0.08$, however, indicates that the domain (major) difference was moderately significant (Cohen, 1988).
To examine the pairwise group differences Hedges’s $g$ was calculated. The largest effect was found between the science and art majors ($g = .71$), with the science majors outscoring the art majors (see Table 3 for means). The science and education ($g = .39$) and education and art ($g = .29$) comparisons demonstrate small to medium effect sizes.

Self-perceived analytical-thinking ability was assessed further during the one-on-one interviews with the students. When they were asked if they felt "intellectual" in high school, the students from the three domains responded differently. Most of the science majors said that they had not felt intellectual, although the quantitative analysis indicated that they had the highest analytical-thinking ability scores. They were more likely to describe themselves as "normal"; one was just interested in passing courses. One science student, who did feel intellectual, recognized that she learned quickly and liked subjects that others hated. The art majors were evenly split on the topic of high school intellectuality. Two individuals felt that they were intellectual because they had skipped grades and/or attended honors classes. One of the other two individuals felt unable to compete with some other students ("… never felt like I could keep up with those kids."). and one was not into "thinking deep thoughts." Finally, all of the education majors considered themselves intellectual in high school. They cited taking honors classes, feeling "nerdy," being accepted into special programs, and striving to be as smart as others as reasons for labeling themselves as intellectual.

**Creative-thinking ability.** No statistically significant difference was found in verbal creative-thinking ability scores for the three majors, $F(2, 35) = 1.66, p = .21$. The effect size, $\eta^2 = .09$, however, indicates that the domain (major) difference was moderately significant (Cohen, 1988). There was no statistically significant or practically
significant difference in non-verbal creative-thinking ability scores, \( F(2, 35) = .48, p = .62, \eta^2 = .03. \)

To examine the pairwise group differences on the verbal test, Hedges’s \( g \) was calculated. A medium effect was found between the education and science majors (\( g = .66 \)), with education majors outscoring the science majors (see Table 3 for means). The art and science (\( g = .48 \)) and education and art (\( g = .27 \)) comparisons demonstrated small to medium effect sizes.

During the interviews all but two of the students, one science major and one education major, considered themselves to be creative in high school. Science and art majors supported their creativity with claims of playing music, writing poetry and stories, and “doing art”. Education majors cited writing, photography, painting, and “fundraising ingenuity” as creative outlets. Of the two individuals who did not consider themselves creative, one said that he had no interest in music or art and the other said that she enjoyed music and poetry, but did not consider herself gifted in those areas.

**Motivation.** There was not a statistically significant difference in the Self Assessment Questionnaire: Motivation (SAQ-M) scores among the three domains, \( F(2, 35) = 2.66, p = .08 \). The effect size was moderately large, \( \eta^2 = .13 \) (Cohen, 1988), indicating that the difference among the domain was practically significant.

Pairwise comparisons (Hedges’s \( g \)) showed a very strong difference between the education and art groups (\( g = .95 \)). The education majors had a higher average motivation score than the art majors. The other two group comparisons demonstrated relatively moderate effect sizes: science and art (\( g = .43 \)) and education and science (\( g = .42 \)).
In order to understand the students’ motivational perspectives, the participants were asked to give the three most important reasons why they chose their current major on the SAQ-M questionnaire. The answers varied, from interest, to financial reasons, to social responsibility. Each major seemed to have one reason that was most prevalent, and it was different for each set of majors. The art majors were seeking happiness, the science majors had interest in their field, and the education majors wanted to contribute to society. Table 13 provides students’ response categories to the question.

Table 13

*Frequency of Reasons Why Students Chose Their Current Path of Study by Three Majors*

<table>
<thead>
<tr>
<th>Reasons for major choice</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribute to society</td>
<td>3</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Seeking happiness</td>
<td>9</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Career opportunities</td>
<td>6</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Love of learning</td>
<td>3</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Wanted a challenge</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Interest in field</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Internal / emotional reasons</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Financial</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Escape time</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Skill in field</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Parental influence</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Wanted respect</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>5</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

The science majors were more likely to cite an interest in science than any other reason. Eight of the twelve students surveyed detailed an interest in science. Other popular reasons were financial opportunities (4 students) or the pursuit of a challenge (4 students).
The art majors expressed their reasons for choosing their current major somewhat differently. Nine out of the twelve art majors indicated that their field makes them happy. Most of these students actually used a form of the word “enjoy” in their statement. One of the next most popular categories had to do with career opportunities associated with their careers. These six students often wanted to teach or travel as a musician. An internal struggle associated with their art also propelled some of the art majors into their field. A poetry major who stated, “compelled to write poetry very often” and a music major who indicated that, “music moves me emotionally in a way that nothing else does” represent the four students within this category.

Social responsibility was cited sixteen times by the education majors. In fact, only one student did not cite a form of social responsibility as a reason for choosing this major. Another popular reason for choosing education was a desire to continue learning (7 students).

Selected participants were interviewed about the reason they chose their current field of study. The science and art students had very similar answers. They conveyed their passion for their field and how much they enjoyed it. The science students also discussed intellectual stimulation as a reason for choosing their field. The education majors were much more likely to cite altruistic reasons for pursuing their current field of study. Several students spoke of giving or paying back as a primary reason for working in the schools and completing their graduate degree. Some of the education students thought that since they were "effective with youth" that this might be a good fit for them. One student also mentioned the issue of job placement and security, stating that there will always be a need for teachers. None of the education students, however, had considered
becoming teachers when they were in high school. When asked about this, one student commented, “You know it never crossed my mind to be a teacher. It really didn’t.” and another stated, “I can’t ever remember thinking I want to teach.” When comparing the science and arts majors with the education majors it was apparent that the first two groups followed their interests and passion whereas the education majors seemed to "end-up" as teachers.

Interviewees were then asked what they would do if they were given the opportunity to choose their major again. Students were generally happy with their choice of study. The science majors were split between the physics and chemistry majors. The physics majors would choose their career path again, stating that they still found it interesting and that they still liked it. The chemistry majors, however, said that they would not choose their path again. One would rather pursue english because of his genuine love of poetry and literature, or physics since his research is more closely associated with physics than chemistry. He was concerned, however, about his ability to earn a living with an english degree. The other would prefer education or a more “bum type lifestyle,” releasing any “arrogance” and “prestige” associated with the sciences. Three of the four art majors said that they would choose their field again. One suggested that she would probably have also earned a minor in a different field as a "back-up" plan. A creative writing major stated that he felt compelled to write poetry regardless of his actual profession. Only one creative writing student would not have followed the same path, opting instead for a career in psychology. This preference was made since she has found the same amount of “red tape” in poetry as she was trying to avoid in her first love of psychology. Of the education majors, three students would have chosen this career
path again, and one other student would only commit to a "maybe." Although some of these students were not planning on remaining teachers, they all felt that either being in the field of education or being an advocate for educational improvement was important to them.

Participants were also interviewed about the reason they were working toward a graduate degree. Interviewees from all groups thought that earning a graduate degree was required for their future. Either to get a good job, to teach at the collegiate level, or as an actual requirement for their teaching program, the students felt compelled to get their degree. Students from the science and art majors also described a sense of personal accomplishment associated with getting an advanced degree and enjoyed the opportunity to learn more about their field. Some of the art majors described graduate school as a type of holding place, where they could advance their skills without having to go and get a job. Several of the education majors cited the raise that accompanies an advance degree and the opportunity to learn to be a more qualified teacher.

Environment. There was not a statistically significant difference in the Self Assessment Questionnaire: Social and Environmental (SAQ-SE) scores among the three domains, $F(2, 35) = 2.09, p = .14$. However, the effect size, $\eta^2 = .11$, was moderately large and practically significant.

The education and art majors had a difference in SEQ-SE scores, with a moderately large effect size ($g = .69$), as did the education and science majors ($g = .68$). In both of these comparisons, the education majors had higher environment scores, indicating a more supportive adolescent environment. There was no difference between the art and science majors ($g = .05$).
The participants were also asked in the SAQ-SE questionnaire to list things that their schools, families, and friends did to help them develop their interests and talents. These answers seemed to be similar across the three disciplinary domains with some schools being supportive and some less so, families being generally supportive, and friends being supportive in several different ways. Table 14 outlines the students’ responses about their schools.

Table 14

*Frequency of School Related Support by Three Majors*

<table>
<thead>
<tr>
<th>Types of school support</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good teachers</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Special programs/classes</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Extracurricula</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Performance opportunities</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nothing</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Bad teachers</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>No response</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

When asked what their high school did to help develop the students’ interests and talents, there was a dichotomy of answers within each area of expertise. The science majors cited both positive and negative attributes of their schools. Five students listed positive support that their schools had provided, like good teachers and specialized programs. Two of the science students indicated that their schools did not do anything to help develop their interests, one student indicated that her chemistry teacher actually discouraged her from studying science, and four students did not offer a response.
The art students also offered both positive and negative school attributes. Seven of the twelve students thought that their schools aided them in their interest pursuits through the use of tools like good teachers and specialized coursework. Of the other five students, three indicated that their schools did not support their interests and two students did not give a response.

Ten of the fourteen education majors had positive things to report about their high schools, such as good teachers and extracurricular opportunities. The other four students wrote that their schools did not do much to support their interests.

In brief, students in all three of the fields of study reported how their schools both supported and failed to support their interests and talents. All groups cited good teachers and special programs or classes, although all groups also claimed that some schools did not do anything to support their interests and talents.

The students were then asked to detail anything that their family did to help them to develop their interests and talents. In this section students were sometimes inclined to give more than one answer. Table 15 outlines the students’ responses.

The science students cited parental understanding and emotional support (3 students), freedom to choose interests (2 students), and financial support (1 student). Not all students had positive things to say about their familial involvement in their interests. One student said that his family was generally unsupportive of his choice to pursue science, and that they had wanted him to go into business. One student claimed that his family did “Nothing” to support his interests, and 4 students did not answer this item.
Table 15

*Frequency of Family Support by Three Majors*

<table>
<thead>
<tr>
<th>Types of family support</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding &amp; emotional Support</td>
<td>7</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Freedom of choice</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Financial support</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Required practice/tutoring</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>High expectations</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Sibling competition</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unsupportive</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Nothing</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>No response</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

All of the art students answered this item, with an overwhelming response for emotional support (7 of 12 students). There were no overtly negative answers.

In education 8 out of the 14 students reported encouragement from their families in response to their interests. All of the education students in general responded to this item with relatively positive responses.

Next, the students were asked what their friends did to help them develop their interests and talents. Table 16 outlines the students’ responses.

Without a standout category of majority, the science majors listed several attributes about their friends that pertained to their interests or lack thereof. One student claimed that his friends did nothing to support his interests and five students did not respond to this item.
Table 16

*Frequency of Peer Support by Three Majors*

<table>
<thead>
<tr>
<th>Types of social support</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Similar interests</td>
<td>6</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Encouragement/support</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Non-academic friendship</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Study groups</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Healthy competition</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Kept out of trouble</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Nothing</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No response</td>
<td>4</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

Half of the art students’ friends held similar interests (6 students). There were no negative responses, however four students did not respond to this item.

Four of the education students used their friends as a support system. Some of them shared interests with their friends, including playing on sports teams (4 students). Three of the education students did not respond to this item, but all of the responses gave positive aspects of the students’ friends.

The environmental support for all majors was considered in the areas of schools, families, and friends. The responses for all participants were generally very similar in that the opinion of the level of support given by their high schools was student specific across all majors, families were mostly supportive, and friends tended to hold similar interests and were supportive of the students.

**Research Question 2**

Do graduate students from three domains differ in subscale scores in (1) verbal and non-verbal creative-thinking ability, (2) self-reported adolescent motivation
attributes, (3) self-reported adolescent environmental backgrounds, and (4) their self-reported adolescent activities? This question was tested by profile analysis.

**Creative-thinking ability.** Multivariate repeated measures ANOVA analyses, or profile analyses, were performed on the verbal and non-verbal components of the Abbreviated Torrance Test for Adults (ATTA). Each of these components had subscales of fluency and originality. The grouping variable was domain as defined by their college major (art, science, and education).

**Verbal creative-thinking ability.** Although the profiles, seen in Figure 1, did not demonstrate a statistically significant interaction, $F(2, 35) = 31.59, p = .22$, the effect size was medium, $\eta_p^2 = .08$. With the practical significance found in the interaction effect, simple effects were analyzed with a conservative significance level (.01).

In the first simple effects analysis, practically significant group (three majors) differences were demonstrated in Fluency, $F(2, 35) = 1.02, p = .370, \eta_p^2 = .06$, and Originality, $F(2, 35) = 2.61, p = .09, \eta_p^2 = .13$. Effect sizes ($g$) were computed to examine the pairwise differences of the three majors in the follow-up simple contrast analysis. When only originality scores were analyzed, the education majors were higher than the science, $g = .83$, and art majors, $g = .61$. The art majors’ average verbal fluency score was higher than that of the science majors, $g = .51$, and the education majors’ average verbal fluency score was also higher than that of the Science majors, $g = .45$. The average verbal fluency scores for the art and education majors were similar, leading to a very small effect size, $g = .05$. See Table 17 for a complete list of the $g$ values.
Figure 1. Estimated marginal means for verbal creative-thinking ability of three majors.

Table 17

*Subscale Hedges’s g Scores for Verbal Creative-Thinking Ability for Combinations of Three Majors*

<table>
<thead>
<tr>
<th>Test</th>
<th>Art - Science</th>
<th>Art - Education</th>
<th>Science - Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency</td>
<td>.51</td>
<td>.05</td>
<td>.45</td>
</tr>
<tr>
<td>Originality</td>
<td>.22</td>
<td>.61</td>
<td>.83</td>
</tr>
</tbody>
</table>

*Note. g values > 0.40 are in boldface.*
The second test of simple effects evaluated the differences in types of verbal creativity (fluency and originality) within each graduate major, using Hedges’s $g$. In each of the majors the fluency score was larger than the originality score: art, $g = 1.63$, science, $g = 1.47$, and education, $g = 0.87$. However, examining the two subscale scores—fluency and originality— is not meaningful because the originality score was computed based on fluency (count) (Goff & Torrance, 2002).

**Non-verbal creative-thinking ability.** The profiles, seen in Figure 2, did not demonstrate a statistically significant interaction, $F(2, 35) = .59, p = .56$. The effect size, $\eta_p^2 = .03$, was small. The subscale main effect was statistically significant, $F(1, 35) = 50.96, p \leq .001$, with a large effect size, $\eta_p^2 = .59$, with the fluency mean score showing higher than that of originality. Again, this result is not surprising. The group (major) main effect was not statistically significant in creative-thinking ability, $F(2, 35) = .481, p = .62$. The effect size was small, $\eta_p^2 = .03$. 
Figure 2. Estimated marginal means for non-verbal creative-thinking ability of three majors.

Motivational components. The seven subscales of the Self Assessment Questionnaire: Motivation (SAQ: M) (mastery goals, performance goals, effort, intrinsic motivation, extrinsic motivation, interest, and self-efficacy) were analyzed for differences among the subscales, with the graduate major (art, science, education) as a grouping variable.

The profiles, seen in Figure 3, did demonstrate a significant interaction and strong practical significance, \( F(12, 62) = 2.03, p = .04, \eta^2_p = .28 \). This analysis indicates that
there were differences among the motivational attributes when college major was taken into account.

![Figure 3. Estimated marginal means for motivation of three majors.](image)

1 = Mastery goals; 2 = Performance goals; 3 = Effort 4 = Intrinsic; 5 = Extrinsic; 6 = Interest; 7 = Self-efficacy.

Having found a statistically significant interaction between major and motivation subscale scores, analyses for simple effects and simple contrasts were performed.

In the first simple effects analysis, examining the difference in motivation subscale scores among the three graduate majors within each motivation subscale, both statistically and practically significant group (three majors) differences were
demonstrated in extrinsic motivation, $F(2, 35) = 3.691, p = .04, \eta^2_p = .17$. A practical significance was also found in performance goals ($\eta^2_p = .15$), effort ($\eta^2_p = .13$), and intrinsic motivation ($\eta^2_p = .14$). Follow-up simple contrast analyses were conducted to examine pairwise group differences. Within the subscale of extrinsic motivation, there was a statistically and/or practically significant difference between the art majors and the science majors ($p = .045, g = 1.01$) and the education majors ($g = .80$). The art majors reported a lower average score on the extrinsic motivation subscale than the other two majors (see Table 18 for means). Within the performance goal subscale, the education majors had a higher average score than both the art ($g = .94$) and science majors ($g = .62$). On the effort subscale, the education majors reported a higher average score than the art majors ($g = .86$). On the subscale of intrinsic motivation, the education majors had a higher average score than both the science ($g = .69$) and art majors ($g = .82$).

The second test of simple effects evaluated the differences of the reported motivational scores within each graduate major. Statistical and/or practical significances were demonstrated in each of the three majors: art, $F(6, 30) = 4.70, p = .002, \eta^2_p = .49$; science, $F(6, 30) = 2.29, p = .062, \eta^2_p = .31$, and education, $F(6, 30) = 10.23, p < .001, \eta^2_p = .67$. Simple contrasts showed that in the art major, the average intrinsic motivation score was higher than that of extrinsic motivation ($p = .003, g = .88$) and mastery goal orientation ($g = .52$). The average score for self-efficacy was higher than that of extrinsic motivation ($p = .002, g = .81$). Also within the art major, the average extrinsic motivation score was lower than that of performance goal orientation ($g = .56$). Table 19 presents all $g$ values for the art major.
Table 18

*Subscale Means for Motivation by Three Majors*

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mastery goal orientation</td>
<td>2.58</td>
<td>2.69</td>
<td>2.86</td>
</tr>
<tr>
<td>Performance goal orientation</td>
<td>2.81</td>
<td>3.04</td>
<td>3.48</td>
</tr>
<tr>
<td>Effort</td>
<td>2.64</td>
<td>2.94</td>
<td>3.26</td>
</tr>
<tr>
<td>Intrinsic motivation</td>
<td>3.17</td>
<td>3.24</td>
<td>3.59</td>
</tr>
<tr>
<td>Extrinsic motivation</td>
<td>2.19</td>
<td>2.88</td>
<td>2.73</td>
</tr>
<tr>
<td>Interest</td>
<td>2.71</td>
<td>2.67</td>
<td>2.52</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>3.08</td>
<td>3.07</td>
<td>3.26</td>
</tr>
</tbody>
</table>

Table 19

*Hedges’s g for Motivation Subscale Scores of the Art Majors*

<table>
<thead>
<tr>
<th>Subscales</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. Mastery goals</td>
<td>--</td>
<td>0.21</td>
<td>0.05</td>
<td>0.52</td>
<td>0.36</td>
<td>0.12</td>
<td>0.45</td>
</tr>
<tr>
<td>2. Performance goals</td>
<td>--</td>
<td>0.15</td>
<td>0.32</td>
<td>0.56</td>
<td>0.09</td>
<td>0.24</td>
<td></td>
</tr>
<tr>
<td>3. Effort</td>
<td>--</td>
<td>0.47</td>
<td>0.41</td>
<td>0.41</td>
<td>0.06</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td>4. Intrinsic motivation</td>
<td>--</td>
<td>--</td>
<td>0.88**</td>
<td>0.41</td>
<td>0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Extrinsic motivation</td>
<td>--</td>
<td>0.47</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.81**</td>
</tr>
<tr>
<td>6. Interest</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.33</td>
</tr>
<tr>
<td>7. Self-efficacy</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note. g values > 0.50 are in boldface.*

**p < .01.

The science majors did not have any statistically or practically significant differences in their motivation subscale scores (see Table 20).
Table 20

Hedges’s g for Motivation Subscale Scores of the Science Majors

<table>
<thead>
<tr>
<th>Subscale</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. Mastery goals</td>
<td></td>
<td>0.29</td>
<td>0.20</td>
<td>0.44</td>
<td>0.15</td>
<td>0.02</td>
<td>0.31</td>
</tr>
<tr>
<td>2. Performance goals</td>
<td>-</td>
<td>-</td>
<td>0.08</td>
<td>0.16</td>
<td>0.14</td>
<td>0.30</td>
<td>0.02</td>
</tr>
<tr>
<td>3. Effort</td>
<td>-</td>
<td></td>
<td>0.24</td>
<td>0.05</td>
<td>0.22</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>4. Intrinsic motivation</td>
<td>-</td>
<td></td>
<td></td>
<td>0.29</td>
<td>0.46</td>
<td>0.14</td>
<td></td>
</tr>
<tr>
<td>5. Extrinsic motivation</td>
<td>-</td>
<td></td>
<td></td>
<td>-</td>
<td>0.17</td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>6. Interest</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>-</td>
<td>0.33</td>
<td>-</td>
</tr>
<tr>
<td>7. Self-efficacy</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

Note. g values > 0.50 are in boldface.
* p < .05, ** p < .01, *** p < .001.

Finally, the average interest score in the education major was lower than that of intrinsic motivation ($p < .001$, $g = 1.19$), performance goal orientation ($p = .002$, $g = 1.07$), self-efficacy ($p = .03$, $g = .83$), and effort ($p = .03$, $g = .82$). Their average extrinsic motivation score was lower than that of intrinsic motivation ($p = .005$, $g = .96$), performance goal orientation ($p = .002$, $g = .84$), self-efficacy ($g = .59$), and effort ($g = .58$). The education majors’ average mastery goal orientation score was lower than that of intrinsic motivation ($p = .01$, $g = .82$) and performance goal orientation ($g = .70$). See Table 21 for all of the education major g values.
Table 21

Hedges’s g for Motivation Subscale Scores for the Education Majors

<table>
<thead>
<tr>
<th>Subscale</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. Mastery goals</td>
<td>--</td>
<td>0.70</td>
<td>0.44</td>
<td>0.82*</td>
<td>0.14</td>
<td>0.38</td>
<td>0.45</td>
</tr>
<tr>
<td>2. Performance goals</td>
<td>--</td>
<td>0.25</td>
<td>0.12</td>
<td>0.84**</td>
<td>1.07**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Effort</td>
<td>--</td>
<td>0.37</td>
<td>0.58</td>
<td>0.82*</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Intrinsic motivation</td>
<td>--</td>
<td></td>
<td>0.96**</td>
<td>1.19***</td>
<td>0.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Extrinsic motivation</td>
<td>--</td>
<td></td>
<td>0.24</td>
<td>0.59</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Interest</td>
<td>--</td>
<td></td>
<td></td>
<td>0.83*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Self-efficacy</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. g values > 0.50 are in boldface.
* p < .05. ** p < .01. *** p < .001.

Interview questions addressed adolescent motivation during high school.

Questions regarded goal orientation, effort, intrinsic and extrinsic motivation, interest, and self-efficacy. When exploring participants’ goal orientation in their adolescent years, they were asked about their primary goal in high school. Participants’ descriptions were similar across the majors. Earning good grades was prevalent overall; at least half of the students in each group specified that getting good grades was their primary goal in high school. There was also a special focus on getting into a good college or earning scholarships. Learning was the second most popular goal for the students. This preference was usually qualified by a special interest in certain types of courses. “I was always worried about the grade, so even if I didn’t like the teacher, didn’t like the class, the grade was always important. But, literature classes, really anything literacy based, reading, social studies…, the social sciences in general, I was very interested in learning.”
(education major) Only one education major claimed that having fun was their primary goal in high school.

The participants were asked if they encountered difficult tasks in high school, and what they did when they encountered them. The art majors seemed to cite more encounters of difficult tasks as adolescents. Three of the four art students cited difficulties whereas only one of the education majors and one of the science majors reported difficulties. The difficult tasks tended to concern coursework. Their coping mechanisms of working harder or soliciting assistance were similar across the students from all three groups.

Intrinsic and extrinsic motivations were explored by asking students their reasons for choosing a field to study. They were prompted with the options of a path that would make you happy, one that would lead to a well-paying job, or one that would lead to public recognition. Happiness was chosen the most in all categories, with all of the science and art majors claiming it as their primary motivation. The one education major who initially chose to major in college in a field that would lead to a well-paying job changed her undergraduate major because she was not happy.

To explore the topic of interest, the students were asked about their interest level during high school for their current field. Only the physics majors within the science major demonstrated early interest in their current field of study. The chemistry majors were largely uninterested in chemistry during their adolescence. The art majors were interested, but not to an intense degree. Two students claimed that their art was just a hobby in high school; one stated that her writing class was one of her favorites, and one said that she was interested in music, but unwilling to practice. Three of the education
majors had no interest in the field of education in high school, and one had a minimal level of interest.

When describing other fields of study that interested them, the science majors listed music, poetry, and literature in addition to topics like biology and economics. The art majors listed topics such as chemistry, biology, and math in addition to topics such as digital art, music and theater. The education majors were likely to list business, political science, and non-profit work; however, science and journalism were also mentioned.

The students were then asked why they chose their current path of study over one of their other interests. Participants majoring in science and arts were more likely to claim aptitude and interest as reasons for pursuing the current field of study. One of the music majors stated that he chose music over other areas because it was "more fun" and he could "always go back to school (for another topic)." The education majors were more likely to cite altruistic reasons, including wanting to "inspire children" and feeling the desire to "give back" to the community. No indication of aptitude or specific interest was given by the Education majors.

Self-efficacy was explored by asking the participants about their confidence in dealing with problems or unexpected situations. The art and education majors were very confident in their ability to solve problems. Most of the science majors referenced overcoming early problems as a measure of their problem solving ability. All students were confident in their problem solving abilities.

Environmental components. To analyze the differences in the students’ social relationships and environments, a profile analysis was performed on three subscales of the Self Assessment Questionnaire: Social and Environmental (SAQ: SE). The SAQ: SE
measured school, family, and social environmental support during adolescence. The grouping variable was the graduate major (domain).

The profiles, seen in Figure 4, did not demonstrate a significant interaction effect, \( F(4, 70) = 0.74, p = .57, \eta^2_p = .04 \). Following with a test of main effects, the subscale scores were not significantly different either statistically or practically, \( F(2, 34) = .80, p = .46, \eta^2_p = .05 \). The group (major) difference in the social and environmental support was not statistically significant, but the effect size was between moderate and large, \( F(2, 35) = 2.09, p = .14, \eta^2_p = .11 \). The largest difference was demonstrated between the education and art majors \( (g = .71) \). There was also a moderately large practical significance demonstrated between the education and science majors \( (g = .68) \), but not between the art and science majors \( (g = .05) \). The education majors reported higher average environmental support scores than the other two majors.

While exploring the environmental circumstances of the interview participants, questions were asked referring to their high school, family, and social situations. These questions were used to understand the outside influences affecting the adolescents’ talent development, such as what was done by each of the environmental factors to influence the students to pursue the area they are currently studying.
Students from all three groups described their high schools as promoting their interests through the offering of specialized advanced courses of different types. Some courses were offered only to specific individuals in the form of an online course, some schools offered non-credit after school courses for Advanced Placement (AP) training, and some schools required students to choose college courses to take for their credits. These options allowed students the freedom to explore more advanced topics while in high school. Multiple students from each of the three groups expressed gratitude for specific instructors. Although not all of the students considered these teachers to have been mentors to them, they did inspire the students to some degree. Science teachers, especially chemistry instructors, were more likely to have been remembered as

Figure 4. Estimated marginal means for environment of three majors.
influential, than those teaching other subject matters, regardless of graduate school major. Some school experiences were less supportive, however. One education student stated that although she initially wanted to be a writer, her school counselor told her that unless she wanted to “live in a loft and eat refried beans for the rest of (her) life,” she should find another career path.

Although the families of all of the students were generally supportive in regards to the development of their interests, it was the parents of the education majors who were more likely to be reported as “pushing” for success from their children. All of the groups had parents who would financially support music lessons, or other interests. The education majors' parents were more likely to have a background in education and they urged their children to do as well as possible. One of the education major’s parents emphasized getting an advanced degree, regardless of the field. Although some of the art majors' extended families did not support the students' decisions in regards to their interests, all of the immediate family members were described as supportive.

When considering family background in the students' major area, often some familial connection could be made. The physics students’ fathers who are computer or electrical technicians, a writer whose father and grandfather were journalists, or teachers whose parents or grandparents were teachers. There were only two students—one science and one education major—who could not draw a familial connection to their major.

It is interesting to note that not one of the students had a sibling with the same talents. One was similar, when an instrumental musician's sister was a singer, but examples such as the science major whose brother works as a police officer or of the education major whose sister is in a pre-dentistry program were more likely to be found.
Social support from the students' peers was generally positive or neutral. The students' friends were not necessarily interested in the same subjects as the participants, but they were described as being supportive and smart. These differences were described as being positive, as they often elicited debate and a search for "common ground." Many of them were in the same classes as the students, or were in the same extracurricular activities. Only two individuals described how their friends distracted them from their interests: one of the science majors whose friends wanted him to spend more time playing music in a band, and one of the music majors whose friends distracted her from playing music. One science major’s friends served as an example of what she did not want. Looking at her friends she would think, “I don’t really want to be like you. It made you see more potential in yourself.”

**Activities and accomplishments.** When comparing the differences in students’ extracurricular activities, thirteen subscales of the Activities and Accomplishments Inventory: College II (AAI: College II) were analyzed. They included science, dance, business, music, technology and computer, architecture, theater and film, mathematics, social leadership, creative writing, visual arts, sports, and educational activities. The grouping variable was the major (art, science, and education).

The profile analysis, seen in Figure 5, demonstrated an interaction between adolescent activities and graduate school major, $F(20.33, 355.69) = 3.590$, $p < .001$, with a large effect size of $\eta^2 = .17$. This indicates that students in different majors participated in different activities during adolescence.
Next, simple effects and simple contrasts were analyzed. The first simple effects analysis examined the difference in activity scores among the three graduate majors within each activity domain. Statistically and practically significant group (three majors) differences were demonstrated in theater, mathematics, and social leadership: theater, $F(2, 35) = 10.12, p < .001, \eta_p^2 = .37$; math, $F(2, 35) = 9.12, p = .001, \eta_p^2 = .34$; and social leadership, $F(2, 35) = 8.17, p = .001, \eta_p^2 = .32$. In addition to these three activity domains, practical significance was also found in music ($\eta_p^2 = .15$), visual arts ($\eta_p^2 = .13$),
and sports ($\eta_p^2 = .12$). Hedges’s $g$ effect sizes were computed to examine the pairwise differences of the three majors in the follow-up simple contrast analysis (see Table 22).

Table 22

Subscale Means for Activities by Three Majors

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>0.59</td>
<td>0.82</td>
<td>0.88</td>
</tr>
<tr>
<td>Dance</td>
<td>0.55</td>
<td>0.22</td>
<td>0.36</td>
</tr>
<tr>
<td>Business</td>
<td>0.38</td>
<td>0.22</td>
<td>0.29</td>
</tr>
<tr>
<td>Music</td>
<td>1.63</td>
<td>0.93</td>
<td>0.75</td>
</tr>
<tr>
<td>Technology &amp; computer</td>
<td>0.42</td>
<td>0.69</td>
<td>0.72</td>
</tr>
<tr>
<td>Architecture</td>
<td>0.18</td>
<td>0.09</td>
<td>0.23</td>
</tr>
<tr>
<td>Theater</td>
<td>1.13</td>
<td>0.23</td>
<td>0.25</td>
</tr>
<tr>
<td>Mathematics</td>
<td>0.22</td>
<td>1.31</td>
<td>0.80</td>
</tr>
<tr>
<td>Social leadership</td>
<td>0.57</td>
<td>0.74</td>
<td>1.91</td>
</tr>
<tr>
<td>Writing</td>
<td>0.77</td>
<td>0.64</td>
<td>0.74</td>
</tr>
<tr>
<td>Visual arts</td>
<td>0.94</td>
<td>0.37</td>
<td>0.95</td>
</tr>
<tr>
<td>Sports</td>
<td>0.44</td>
<td>0.42</td>
<td>1.00</td>
</tr>
<tr>
<td>Educational activities</td>
<td>0.89</td>
<td>0.99</td>
<td>1.30</td>
</tr>
</tbody>
</table>

Within the domain of theater activities, there was a statistically and practically significant difference between the art majors and both the science ($p = .001, g = 1.31$) and education majors ($p = .001, g = 1.34$). The art majors reported higher scores on the theater domain than the other two majors (see Table 23 for means). Within the mathematics activities domain, the science majors scored higher than the art majors ($p < .001, g = 1.65$). The science majors also reported higher scores than the education majors ($g = .69$) and the education majors reported higher scores than the art majors ($g = 1.09$). In the domain of social leadership activities, the education majors scored higher than both the science ($p = .01, g = 1.19$) and art majors ($p = .002, g = 1.32$). Within the music
In the activities domain, the art majors reported higher scores than both the science \((g = .78)\) and education majors \((g = .80)\). In the visual arts activities domain, the science majors scored lower than both the art \((g = .86)\) and education majors \((g = .82)\). In the sports activities domain, the education majors scored higher than both the science \((g = .71)\) and art majors \((g = .63)\). Finally, in the domain of technology and computer activities, the education majors reported a higher rate of activities than the art majors \((g = .69)\). Tables 22 and 23 present subscale means for the three majors and the \(g\) values, respectively.

The second test of simple effects evaluated the differences of the reported activities within each graduate major. Statistical and practical significances were demonstrated in each of the three majors: art, \(F(12, 24) = 8.11, p < .001, \eta^2_p = .80;\) science, \(F(12, 24) = 5.63, p < .001, \eta^2_p = .74;\) and education, \(F(12, 24) = 6.72, p < .001, \eta^2_p = .77.\) Simple contrasts showed that in the art major, the average music activity score was higher than that of architecture \((p = .03, g = 1.23)\), mathematics \((p = .002, g = 1.19)\), business \((p = .03, g = 1.06)\), technology and computer \((p = .04, g = 1.02)\), sports \((g = 1.01)\), dance \((g = .91)\), social leadership \((g = .89)\), science \((g = .87)\), writing \((g = .72)\), educational activities \((g = .63)\), and visual art \((g = .58)\). Also within the art major, the average theater activity score was higher than that of business \((p = .001, g = .64)\), architecture \((p < .001, g = .80)\), mathematics \((p = .049, g = .77)\), technology and computer \((g = .60)\), and sports \((g = .58)\). There were other differences in domain activities that demonstrated practical significance. Table 24 presents all \(g\) values for the art major.
Table 23

Hedges's g for Activities and Accomplishments Subscales

<table>
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<tr>
<th>Subscale</th>
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</tr>
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</table>

Note. g values > 0.30 are in boldface.
* p < .05. ** p < .01. *** p < .001
### Table 24

**Hedges’s g for Activities Subscale Scores of the Art Majors**

<table>
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<td>0.25</td>
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<tr>
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<td>0.11</td>
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<td>-0.49</td>
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<td>-0.02</td>
<td>-0.19</td>
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<td>0.10</td>
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<tr>
<td>3. Business</td>
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<td>-0.17</td>
<td>-0.34</td>
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<td>-0.05</td>
<td>-0.43</td>
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<td>4. Music</td>
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<td>1.23***</td>
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<td>-0.02</td>
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<td>-0.04*</td>
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<td>-0.50</td>
<td>-0.64</td>
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<td>-0.60</td>
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<td>7. Theater</td>
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<td>0.47</td>
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<td>0.58</td>
<td>0.58</td>
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<td>8. Mathematics</td>
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<td>-0.31</td>
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<td>-0.27</td>
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<tr>
<td>10. Creative writing</td>
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<td>0.10</td>
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<tr>
<td>11. Visual arts</td>
<td>-</td>
<td>0.42</td>
<td>0.04</td>
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<tr>
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</tr>
</tbody>
</table>

*Note.* g values > 0.50 are in boldface. Negative value indicates vertical mean value is larger than horizontal. *p < 0.05, **p < 0.01, ***p < 0.001.

The science majors’ average mathematics activity score was higher than that of architecture (p < 0.001, g = 1.64), dance (p = 0.04, g = 1.47), business (p < 0.001, g = 1.47), theater (p = 0.006, g = 1.45), visual arts (g = 1.32), sports (g = 1.20), writing (g = 0.91), technology and computer (g = 0.84), social leadership (g = 0.77), and music (g = 0.52). The science majors also had a higher average educational activities score than that of architecture activities (p = 0.02, g = 1.20), dance (g = 1.03), business (g = 1.03), theater (g = 1.02), visual arts (g = 0.84), and sports (g = 0.77). Table 25 presents g values for these and other differences in the science major.
### Table 25

**Hedges's g for Activities of the Science Majors**

<table>
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<tr>
<th>Subscale</th>
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<th>6</th>
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<th>10</th>
<th>11</th>
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<th>13</th>
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<td><strong>-0.66</strong></td>
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<td>0.25</td>
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<td><strong>-1.47</strong></td>
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<td>-0.20</td>
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<td>3. Business</td>
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<td><strong>-0.95</strong></td>
<td><strong>-0.63</strong></td>
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<td>-0.01</td>
<td><strong>-1.47</strong></td>
<td><strong>-0.70</strong></td>
<td><strong>-0.56</strong></td>
<td>-0.20</td>
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<td>7. Theater</td>
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<td><strong>-1.45</strong></td>
<td><strong>-0.68</strong></td>
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</table>

*Note. g values > 0.50 are in boldface. Negative value indicates vertical mean value is larger than horizontal.

* p < .05, **p < .01, *** p < .001.

Finally, the education majors’ social leadership activities scored higher than all of the other categories, including architecture (p < .001, g = 1.38), theater (p < .001, g = 1.37), business (p < .001, g = 1.34), dance (p < .001, g = 1.28), music (p = .02, g = .96), mathematics (p = .01, g = .91), writing (p = .004, g = .96), technology and computer (g = .98), science (p = .04, g = .85), visual arts (g = .79), sports (g = .75), and educational activities (g = .51). Their average educational activities score was higher than that of theater (p = .03, g = .86), business (p = .01, g = .83), and architecture (p = .001, g = .88). Their average visual arts activity score was higher than that of business (g = .54), architecture (g = .59), and theater (g = .57). The education majors’ average sports activity score was higher than that of business (g = .59), architecture (g = .63), and theater (g = .62). Their average science activity score was higher than both architecture (g = .53) and theater (g = .52). See Table 26 for all of the education major g values.
Table 26

*Hedges’s g for Activities Subscale Scores of the Education Majors*

<table>
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<tr>
<th>Subscale</th>
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<tbody>
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<td>0.49</td>
<td>0.10</td>
<td>0.13</td>
<td><strong>0.53</strong></td>
<td><strong>0.52</strong></td>
<td>0.06</td>
<td>-0.85*</td>
<td>0.11</td>
<td>-0.06</td>
<td>-0.10</td>
<td>-0.35</td>
</tr>
<tr>
<td>2. Dance</td>
<td>--</td>
<td>0.06</td>
<td>-0.32</td>
<td>-0.30</td>
<td>0.10</td>
<td>0.09</td>
<td>-0.37</td>
<td>-1.28***</td>
<td>-0.32</td>
<td>-0.49</td>
<td>-0.53</td>
<td>-0.77</td>
<td></td>
</tr>
<tr>
<td>3. Business</td>
<td>--</td>
<td>-0.38</td>
<td>-0.36</td>
<td>0.04</td>
<td>0.03</td>
<td>-0.43</td>
<td>-1.34***</td>
<td>-0.38</td>
<td>-0.54</td>
<td>-0.59</td>
<td>-0.83*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Music</td>
<td>--</td>
<td>0.02</td>
<td>0.43</td>
<td>0.41</td>
<td>-0.04</td>
<td>-0.96*</td>
<td>0.01</td>
<td>-0.16</td>
<td>-0.21</td>
<td>-0.45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Technology &amp; Computer</td>
<td>--</td>
<td>0.40</td>
<td>0.39</td>
<td>-0.07</td>
<td>-0.98</td>
<td>0.01</td>
<td>-0.18</td>
<td>-0.23</td>
<td>-0.47</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Architecture</td>
<td>--</td>
<td>-0.01</td>
<td>-0.47</td>
<td>-1.38***</td>
<td>-0.42</td>
<td>-0.59</td>
<td>-0.63</td>
<td>-0.88**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Theater</td>
<td>--</td>
<td>-0.46</td>
<td>-1.37***</td>
<td>-0.40</td>
<td>-0.57</td>
<td>-0.62</td>
<td>-0.86*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Mathematics</td>
<td>--</td>
<td>-0.91*</td>
<td>0.05</td>
<td>-0.12</td>
<td>-0.16</td>
<td>-0.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Social leadership</td>
<td>--</td>
<td>0.96**</td>
<td>0.79</td>
<td>0.75</td>
<td>0.51</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Creative writing</td>
<td>--</td>
<td>-0.17</td>
<td>-0.21</td>
<td>-0.46</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Visual arts</td>
<td>--</td>
<td>-0.04</td>
<td>-0.29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Sports</td>
<td>--</td>
<td>-0.24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Educational activities</td>
<td>--</td>
<td>--</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

*Note.* g values > 0.50 are in boldface. Negative value indicates vertical mean value is larger than horizontal. *p < .05, **p < .01, ***p < .001.

To further understand the activities during adolescence beyond those found from the AAI items, several participants were interviewed.

**Activities.** First, participants were asked what extra-curricular activities they participated in while they attended high school. The students were also asked whether they enjoyed the activities, and why they enjoyed them. Then they were asked what activities they wanted to participate in, but were unable to do so. They were also asked why they did not participate in these desired activities.

Students from all three groups reported participating in extra-curricular activities that fell into the categories of sports, bands, and honor societies. The education majors were the only group to list student government positions and volunteering. Tutoring was mentioned by participants in both the science and education majors. Everyone enjoyed their extra-curricular activities, primarily for the social interaction.
Sports were the most popular extra-curricular activities that students of all three majors wanted to participate in, but didn’t or couldn’t. They cited either a lack of ability, a lack of opportunity (the school did not offer programs), or a lack of time as reasons for not participating.

**Accomplishments.** In the Demographics Questionnaire the students were asked to detail their accomplishments from their graduate years. They were asked to separate the accomplishments that were in the area of their graduate program from those that were outside the area of their graduate program. Although some students claimed that they had few if any accomplishments because they had only been graduate students for a couple of months, some students had some very impressive accomplishments. Table 27 presents within-program accomplishments by major.

<table>
<thead>
<tr>
<th>Program accomplishments</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publications</td>
<td>0</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Performances</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Presentations</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Support for others in the field</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Grades</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nothing</td>
<td>0</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>No response</td>
<td>3</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

The art majors focused their accomplishments on school based performances (6 students), published works or work submitted to conferences (2 students), and exemplary
grades as an accomplishment (1 student). One poetry student created an automated program for students at a local art gallery, so that they could have their “work heard publicly.” Another student had a “fiction, poetry, non-profit multimedia civics program.”

Only three of the art students did not respond to this item.

When the science students listed an accomplishment in their graduate area, it was either in the form of publications or presentations. The other students did not feel that they had any accomplishments or they did not answer the item. Those students who had published usually reported that they had co-authored multiple papers. One of the science students claimed 40 of his papers had been published in the Astrophysics Journal.

Only two education students reported graduate area accomplishments. One student published a thesis from a previous master’s degree. Another student created a curriculum aid for math students. The other education students either reported no accomplishments in their graduate area or they did not respond to this item.

Accomplishments outside of the students’ graduate area were also considered. Table 28 gives the cited out-of-program accomplishments by major.

When the art students had outside accomplishments they tended to be related to their academic interests. Two students had given musical performances. Two students, one of whom was majoring in poetry, recorded music. One student wrote film scripts. And one student is an editor of a literary magazine. This left three participants who did not report having any outside accomplishments and three students who did not respond to this item.

Only two science students reported accomplishments outside of their graduate program area. One student placed 2nd in a bouldering (rock climbing) competition.
Another student organized an academic conference. Six students claimed no outside accomplishments and four students did not respond to this question.

Table 28

*Frequency of Outside of Program Accomplishments by Three Majors*

<table>
<thead>
<tr>
<th>Outside accomplishments</th>
<th>Art</th>
<th>Science</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade level chair</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Elem. school classroom achievement</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Recorded music</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Performances</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wrote film scripts</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Literary Magazine editor</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bouldering competition</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Conference organization</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Nominated for “New Teacher of the Year”</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>None</td>
<td>6</td>
<td>10</td>
<td>7</td>
</tr>
</tbody>
</table>

The education majors had some impressive outside-program accomplishments. Five of the students had been promoted to grade level chair at the elementary schools that they worked at. Four students discussed accomplishments that related to their peers or programs within their elementary schools. One of the education students had been nominated for New Teacher of the Year. One student stated no outside accomplishment, three students listed activities or traits that were not accomplishments (e.g., “I was a first year teacher in an underresourced elementary school.”), and three students did not answer this question.
The accomplishments in all categories were quite impressive. They generally seemed to be specific to each group’s area of expertise, and there were high achievements within all groups.
CHAPTER 5

Discussion

Do talented individuals specializing in different areas have different developmental profiles? This was the general question that this research sought to address. Overall impressions from various descriptive statistics are described first, followed by discussions of findings from quantitative and qualitative data analysis, examining both the profile differences among graduate students from three major areas and within each specific major on their current cognitive ability, adolescent personal-psychological attributes and environmental background.

Overall, talented individuals from different major areas did have different developmental backgrounds. Observations of descriptive statistics gave initial impressions of apparent differences in profiles among graduate students from the three fields—art, science, and education. Mean scores demonstrated that there was not one major that consistently outscored the other two, nor were they all similar on the scores of analytical-thinking ability, verbal creative-thinking ability, non-verbal creative-thinking ability, adolescent motivation, environmental factors, and adolescent activities. This indicated that the graduate students in this study might have different strength profiles.

The research questions asked not only if the groups demonstrated differences, but also how the differences were demonstrated throughout the subcomponents of each topic of study. When testing research hypotheses both statistical and practical significance results were used. The latter information was useful as the current sample size was rather small.
Cognitive Abilities

The study of cognitive abilities regards the differences among graduate students from the three major areas on analytical-thinking ability, verbal and non-verbal creative-thinking ability. There were differences among the majors in cognitive abilities.

**Analytical-thinking ability.** As the Raven’s APM was designed to differentiate among people at the high end of intellectual ability (Pearson Assessments, 2012), the moderate levels of average scores on the APM demonstrated by all three majors indicated a moderately high level of analytical ability. This supports the assertion that achievement and talent advancement are reliant on advanced levels of analytical-thinking abilities (Hong & Milgram, 2008a; Lubinski & Benbow, 2006; Terman, 1925). The study of talent development has often started with the measurement of analytical-thinking ability (Gagné, 2004).

The science majors had the highest analytical-thinking abilities, followed by the education majors, and finally the art majors. This does not seem surprising, given that students in the sciences are taught and required to use analytical strategies for their problem solving (Stieff, 2007). Interview narratives, however, were not consistent with the quantitative findings. When participants were asked if they considered themselves intellectual in high school, the education majors considered themselves intellectual more so than the art majors and the science majors. Sternberg, Conway, Ketron, and Bernstein (1981) found that individuals are relatively accurate when reporting their own levels of intelligence, when compared to a hypothetical prototype that illustrates typical qualities of an intelligent person. The difference in reported adolescent intellectual aptitude in the participants possibly stems from the use of alternate prototypes. According to the
interviewed students from this study, high school students are often surrounded by friends with similar interests. When they reported high school intellectual ability, they were likely using their immediate peers as a point of comparison rather than the entire high school student body. This may partially explain the differences between measured analytical-thinking abilities and self-reported adolescent intellectual capacity.

The education majors in this sample were chosen from within a group of teachers who had been viewed as promising effective teachers due to their leadership potential (Teach for America, 2011b). Admission into their organization required a demonstration of such skills as perseverance, critical thinking, planning, and the ability to motivate others (Teach for America, 2011a). Being accepted into this group might have positively affected their perception of their own abilities, as this process was viewed quite competitive (Businessweek, 2009). The perception of intelligence by the education majors might also be explained by one of their own qualitative responses, “I think that I have an inflated sense of my intelligence after dealing with 5th graders.” The education majors were all teaching elementary school at the time of the data acquisition. Perhaps their current positions influenced their perception of their current and past levels of intelligence.

**Creative-thinking ability.** Creative-thinking ability was distinctly different across verbal and non-verbal abilities, which is similar to the results found in Almeida Prieto, Ferrando, Oliveira, & Ferrándiz (2008). This supports the view that individuals of different types of giftedness will have different verbal and non-verbal creative-thinking abilities (Tarver, Ellsworth, & Rounds, 1980) and that the brain processes verbal and non-verbal problems differently (Razumnikova, Volf, & Tarasova, 2009). On verbal
creative-thinking abilities, the education and science majors were significantly different, with education majors outscoring science majors. Art majors’ average score was between the two, yet not significantly different from either. The difference between education and science majors is supported by the narratives of Ambrose (2005) and Feist (2005). Ambrose (2005) speaks to the breadth of skills required by creative teachers, their focus on flexibility within their lessons, and their empathetic relationship with their students. Feist (2005) describes creative scientists as “thing oriented” by genetic and evolutionary predispositions and as being relatively asocial and introverted. That is, according to Ambrose (2005) and Feist (2005), there seems to be significant differences in the communication skills between teachers and scientists.

The verbal creative-thinking ability components, fluency and originality, differed across the majors. Science majors scoring lower than both the art and education majors in fluency and lower than the education majors in originality was somewhat expected. Johnson (1969) found that students in an accelerated science program had a negative relationship between science achievement and verbal creativity as measured by the Torrance Test of Creative Thinking (TTCT), Verbal Test.

Non-verbal creative-thinking ability did not vary between the majors. Although this may be an indication of the domain-general nature of non-verbal creative-thinking (Baer & Kaufman, 2005), it may also be a byproduct of the test construction. With two drawings to complete in three minutes, it is not surprising to find that all groups have average frequency values of about two. Although the study followed the direction of the ATTA, one can expect that a larger number of items could afford a better opportunity to find potentially meaningful differences between the groups.
The lack of a difference between the majors on the non-verbal creative-thinking abilities scale was somewhat surprising, given the differences found on the verbal scale. In this study, the art majors consisted of music and creative writing majors. If visual arts majors were included in the study, the results could have been different. Studies indicated that students who are strong in science tend to score high in nonverbal creative-thinking ability (Blazhenkova & Kozhevnikov, 2009). The current findings with graduate students were not consistent with previous findings, warranting more investigation. Furthermore, the similarities found between the majors could indicate the need for additional domain-specific testing of creative-thinking ability, in addition to the domain-general tests that were used in this study. Testing domain-specific creative-thinking abilities would highlight creative skills necessary in particular fields of study (Hong & Milgram, 2010; Kaufman & Baer, 2005; Silvia, Kaufman, & Pretz, 2009).

The findings do not explicitly substantiate the relationship between analytical-thinking ability and creative-thinking ability found in previous studies (Hong & Milgram, 1996; Livne & Milgram, 2006). This lack of a relationship indicates that if potentially talented students are only evaluated on their analytical abilities (i.e., IQ), then some creatively talented individuals will likely be excluded. The only notable correlations between the analytical- and creative-thinking measures was with the science majors between analytical-thinking and both verbal ($r = .44$) and non-verbal creative-thinking ($r = .61$). The strong relationship found in the science majors of this study suggests that analytical abilities may be an essential component for successful creative work in the science fields. The lower levels of correlations found between general intellectual and creative-thinking abilities were consistent with the findings from Hong and Milgram
(1996) and Livne and Milgram (2006). However, other studies have demonstrated stronger relationships between domain-general analytical-thinking and creative-thinking abilities (Ward, Saunders, & Dodd, 1999; Chen, Himsel, Kasof, Greenberger, & Dmitrieva, 2006). This discrepancy indicates the need for further investigation, perhaps with additional domain-specific measures.

**Personal-Psychological Attributes**

Motivation is the driving force behind behaviors (Pintrich, 2003). Analysis of motivational attributes during adolescence helps understand which attributes were more influential to the participants’ talent development in the field of study they chose. This study questioned not only perceived motivation in adolescence and activities in which they participated, but also the reasons for the participants’ choice of graduate programs of study.

**Motivational attributes.** All motivation subscale scores demonstrated that the graduate students from the three majors reported a relatively high degree of motivation. These results were expected based on the literature relating achievement to effort (Amabile, 2001), goal orientation (Elliot & Harackiewicz, 1996), intrinsic and/or extrinsic motivation (Deci, 1972; Eisenberger and Rhoades, 2001), interest (Sansone & Thoman, 2005), and self-efficacy (Arepattamannil, Freeman, & Klinger, 2011; Pajares, 1996; Walker, Greene, & Mansell, 2006). As the sample included graduate students who have chosen their field of study, it is not surprising to find the relatively high motivation scores.

The education majors demonstrated the highest level of motivation, followed by the science majors, and then by the art majors. This trend was consistent in most of the
subcomponents of motivation measured in this study. Breen and Lindsay’s (2002) study on motivational profiles across different majors among college students found more variation between majors than within majors. They found that for computing, history, biology, and geology majors, sources of enjoyment may be more important than learning goals (e.g., innovation goals, study goals, achievement goals) and general motivational attributes (e.g., self-efficacy, intrinsic motivation, extrinsic motivation), in the pursuit of success. This relationship was not found for the planning, education, food science and nutrition, and anthropology majors. Although they studied somewhat different motivational attributes and college majors as compared to the current study, the differences found among the majors in their study support the general findings that motivation levels are different across college majors.

In the current study extrinsic motivation, intrinsic motivation, performance goals, and effort demonstrated differences among the majors. Adolescent extrinsic motivation scores were higher for science and education majors than art majors, indicating that the art majors were the least likely to be influenced by external stimuli. The education majors had the highest scores for intrinsic motivation and also outscored both art and science majors on the performance goal subscale. Finally, the education majors outscored the art majors on the effort subscale. The findings that the education majors ranked the same or higher than the other two majors on every motivational subscale may be related to the hiring process that the education majors went through. Before being accepted into the educator group, the education students had to provide evidence of having such skills as perseverance, the ability to motivate others, and past “ambitious” achievement (Teach for America, 2011a). All of these traits indicate a high level of motivation, in several
different areas. Studies with teachers who have been rated as excellent, but who did not participate in such hiring process, are needed for the purposes of comparing with various types of teachers and with participants from other domains.

When motivational profile was observed within each major, differences were found. The art major’s adolescent motivations rated highest on intrinsic motivation and lowest on extrinsic motivation. The art majors had exhibited an “art for art’s sake” mentality of creating arts, even at their adolescence. Lacaille, Koestner, and Gaudreau (2007) found a positive relationship between intrinsic goals and both performance and emotional outcomes in artists, which supports the current research.

Analyzing education students with backgrounds in other fields, Williams andForgasz (2009) found the students’ current motivations for becoming teachers to be highly intrinsic and altruistic. They also found most of the participants to have high self-efficacy beliefs about becoming a “good teacher.” The current study found the education majors’ adolescent motivations to have several differences. Their highest scores were on the intrinsic motivation and performance goal orientation subscales. Their lowest scores were on the interest and extrinsic motivation subscales. The dichotomous relationship between intrinsic and extrinsic motivations was expected, but the pairing of intrinsic motivation and performance goal orientation and the opposition of intrinsic motivation and interest seem to contradict each other. However, the findings are corroborated by the participants’ interview responses. In general, the responses from the education majors stated that they wanted an undergraduate major that would make them happy, demonstrating high intrinsic motivation. Their primary goal in high school, however, was to make good grades and get a scholarship, which demonstrates high performance goal
orientations. As none of their undergraduate college majors were in education, it is not surprising that their adolescent interest scores for education are not very high. It is important to note that the actual interest scores indicate that it was not that the education majors had “low” interest, but that it was just not as high as the other values.

Making sense of the science majors’ profiles, however, posed somewhat of a problem. As their motivational subcomponents did not differ, one can surmise either that the sciences attract a varied set of students with varied levels of motivational attributes, or that they were perhaps less attuned to their adolescent motivational processes than the other majors. Glynn, Brickman, Armstrong, & Taasoobshirazi (2011) found differences between undergraduate science and non-science majors on all of the measured factors of motivation. The science majors’ scores in their study did differ across various motivational attributes (intrinsic motivation, career motivation, self-determination, self-efficacy, and grade motivation). For example, the science majors’ average career motivation score was higher than their average self-efficacy score. This variation is contradictory to the current study’s findings.

Interview results indicated that to a large extent the participants chose their majors to fulfill an internal need or desire. Their elevated levels of intrinsic motivation and self-efficacy may be due partially to successful experiences in their respective fields (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Phillips, Hollenbeck, & Ilgen, 1996; Schunk, 1996).

**Adolescent activities.** There was a significant difference between the majors on the scale of adolescent activities. When observing the score differences on specific topics of activities, there is definitely a relationship between adolescent interest and current
graduate school major. The activities and accomplishments subscale scores for the three 
majors showed the activities with the highest participation scores fell in categories that 
are stereotypically associated with their separate fields. The science students were the 
most active in math programs, as compared to the other two majors. The art majors were 
the most active in activities regarding theater and music. Finally, the education majors 
were the most active in areas such as social leadership and sports. These findings indicate 
that as adolescents, the participants had already engaged in activities in the domain of 
their interest, which later evidenced in the choice of their graduate field of study. Similar 
results were found with artistic students in Milgram’s (2003) study on childhood 
activities, where a strong relationship was found between the performance of out-of-
school activities in the domains of visual arts, drama, social leadership, and dance, with 
creative performance or creative product in the corresponding domain. Additionally, 
Feldman and Matjasko (2007) suggest that adolescent students are more likely to be 
involved in multiple areas of extra-curricular activities rather than activities of only one 
type. Their study examined six extracurricular activity portfolios (sports only, academics 
only, school only, performance only, multiple activities, and non-participation). They 
found that most students engaged in multiple activities, with the majority participating in 
just two types of activities. This concept of looking at the types of activities, in addition 
to the domains of activities, may be a supplementary dimension to explore in future 
studies.

When activity preferences were considered within each major, the results 
remained stereotypically consistent. The science majors preferred pursuits in math to all 
of the other activities. The art majors preferred activities in music and theater. The
education majors had higher scores for activities in social leadership, educational activities, visual arts, and science than all of the other activities. From these results, one can surmise that interest is relatively stable between adolescence and graduate school and again that out-of-school challenging activities and accomplishments in adolescents are the indication of talent potential in the area of their choice (Hong & Milgram, 2008a).

The strong correlational evidence provided by longitudinal studies between out-of-school adolescent activities, in various domains, and career choice and accomplishments in corresponding domains (Hong, Milgram, & Whiston, 1993; Milgram, Hong, Shavit, & Peled, 1997) support the current findings with graduate students and their adolescent activities.

Emmett and Minor (1993) also saw that long-term career decisions are often influenced by interests in high school. Most of the interviewed participants reported that they engaged in activities to follow their interests. Interest can be considered as the combination of cognitive and affective components (Sansone & Thoman, 2005). As the self-efficacy scores for all groups of participants were relatively high, they are more likely to make appropriate choices to participate in activities in which they would expect to excel (Bandura, 1993; Bandura et al., 2001; Pajares, 1996). That is, the current participants elected to participate in activities in which they expected to both like and do well.

**Environmental Factors**

The intricate relationships between individuals and their environments afford talent development. Activities in adolescents are manifestation of complex interactions of cognitive abilities, personal attributes, and environmental factors. Environment can
hinder or support the development of talent (Flashman, 2012; Reis, Colbert, & Hébert, 2004). In the current study, most environment-related scores were relatively high with some differences among the majors. As graduate students were considered moderately talented in the trajectory of talent development, these moderately high levels of environmental support were expected in regard to school (Brady, 2005; Coleman, 2002; Kanevsky & Keighley, 2003), family (Cho & Campbell, 2011; Hébert, Pagnani, & Hammond, 2009), and social environment (Emmett & Minor, 1993; Field, et al., 1998; Flashman, 2012; Riegle-Crumb, Farkas, & Muller, 2006).

Education majors reported the highest level of overall environmental support, and there was not a significant difference between the science and art majors on this scale. Scharf and Mayseless (2010) suggest that social leadership is often supported in schools and that social leadership qualities are often associated with pro-social orientations in relation to peers. As the education majors have demonstrated social leadership activities, these results support the claim of advanced environmental support, at least in the school and social realms. However, when the three environmental subscale scores were examined (school, family, and social), differences were not found between or within any of the majors. The lack of a difference on the environmental subscales may indicate that talented individuals from various backgrounds all needed supportive environments in order to succeed, regardless of domain choice. Numerous studies have suggested the benefits of supportive environments, without separating domains (Brady, 2005; Coleman, 2002; Kanevsky & Keighley, 2003; Rathunde, 1996).

The concept that more environmental support will better enable students is an important component of self-regulated learning (Zimmerman, 1989). Drawing from the
social cognitive concept of triadic reciprocality (Bandura, 1977, 1986), self-regulated learning explains how both the physical and social environments have an influence over the learning behaviors of students. In an example of social environments influencing learning, Jones, Estell, and Alexander (2008) contended that peer influence supports the concept of social environmental effects on learning.

Although few of the interviewed participants thought that they had mentors during their adolescence, they often reported especially supportive teachers as being influential. Mentors are usually considered as guides into and through a student’s field of interest. Mentors can affect students’ career choices (Little, Kearney, & Britner, 2010) and internal processes (Ambrose, Allen, & Huntley, 1994). They can be of significant importance to some subpopulations of gifted students, like disadvantaged (Torrance, Goff, & Satterfield, 1998), minority (Ford, 1996), or underachieving gifted students (Hébert & Olenchak, 2000).

Within the literature on talented individuals, there is a lack of research that focuses on either graduate level students or domain differences. This study focused on both areas of concerns (i.e., lack of research). It is apparent from the results that graduate students from different domains (science, art, and education) present different levels and types of strengths and backgrounds. In accordance with Hong and Milgram’s (2008a) Comprehensive Model of Giftedness and Talent, elevated levels of cognitive ability, personal-psychological attributes, and environmental support are likely present in the talented participants from all domains. It is the degree to which various components of personal attributes and environmental backgrounds have differential impacts on these individuals that differentiates the groups.
The graduate students from the three majors differed in their analytical-thinking abilities, verbal creative-thinking abilities, adolescent motivational attributes, and their adolescent environmental backgrounds supporting domain differences. The only area where no group difference was found was non-verbal creative-thinking abilities. In addition, various subcomponents of the four major measurement scales also differentiated graduate students from the three domains. Many of these differences characterized the three major groups, although some findings did not demonstrate the expected differences. These results indicate that more, in-depth, research needs to be conducted to further determine domain differences during the development of talent.

In the literature about talented students, comparisons between domains are rare. Of the few studies that were completed, domain differences were observed (Breen & Lindsay, 2002; Blazhenkova & Kozhevnikov, 2009). Breen and Lindsay (2002) found domain differences between undergraduate majors on motivation (e.g., achievement goals, self-esteem goals, and academic innovation enjoyment) and Blazhenkova and Kozhevnikov (2009) found domain differences in cognitive style. In this research, some of the most distinct domain differences observed, both quantitatively and qualitatively, included those between adolescent motivational factors and adolescent activities and accomplishments. The differences between the majors on the overall scale of adolescent motivation are supported by the distinct differences found when the participants were asked why they chose their current majors. The adolescent activities scale demonstrated differences in activity participation that followed stereotypical interests associated with each major, as did the participants’ interviews about their accomplishments. Although there is a dearth of literature comparing developmental attributes between domains, the
evidence from this research, in addition to the previously published studies, supports the existence of domain differences in various aspects of personal attributes and environmental backgrounds of individuals who demonstrate certain levels of talents.

The most distinct domain differences in this study were within the motivational factors profiles. In addition to the practical significance that was found among the majors on the subfactors, statistically significant differences were also found. The statistically significant results are focused on the differences found not only among the domains in the area of motivational factors, but specifically on the subfactor of extrinsic motivation. The science majors were found to outscore the art majors on this subscale. The practically significant differences highlight differences across many of the subfactors, but the strongest differences were also found on the subfactor of extrinsic motivation, especially between the art and science majors. There were also differences found in the area of external motivation from the qualitative questionnaires. The science majors were considerably more likely to cite financial reasons or the pursuit of respect as the reasons for following their current major than the art majors. This agreement between multiple methods of data analysis serves to strengthen the support of the conclusions of domain differences within the motivational profiles of the three domains.

Importance of Findings

Although there is still much to study, this research demonstrates that talented students in different areas have different developmental profiles. Without the separation of similar academic groups of talented individuals, results of future studies on talent and giftedness may not serve well the understanding of the talent development phenomena. Although there have been studies that isolated a talent area, for example, literature (Piirto,
mathematics (Lubinski & Benbow, 1994; Webb, Lubinski, & Benbow, 2002), music (Davidson & Scripp, 1994), science (Schmidt, 2011; Tang & Neber, 2008), and art (Lacaille et al., 2007), it is important that research should compare talented individuals from different fields. For example, comparing different domains, Achter, Lubinski, and Benbow (1996) disputed the then widely held view, multipotentiality (i.e., high abilities, interests, and activities in many areas), by scholars such as Emmett and Minor (1993). They provided empirical evidence that talented adolescents demonstrate concentrated interest in a single domain and persevere in the selected domain by engaging in out-of-school activities. The current finding, for example, that adolescent interest and activities are related to the graduate field of study, resulted because this study examined more than one domain simultaneously.

The results of this study may have an impact on future gifted and talented students. By studying participants from various talent domains simultaneously to determine the characteristic differences and continuing to examine characteristics of each talent domain in-depth, more specific gifted and talented programs can be designed. By understanding what precise support each talent domain needs, programs that facilitate talent development can be improved.

**Limitations and Future Research**

This study had both general limitations and some that were very specific to this research. Some of the general limitations include non-random selection of participants, using self-report questionnaires, and participant having problems remembering their adolescent period. If randomly selected participants from all departments could have been obtained, the results would have been more generalizable (Shadish, Cook, & Campbell, 1998).
Since participants in this research were volunteers, the data may be reflective of only helpful types of graduate students and may fail to represent accurately those students who chose not to participate in this study.

When self-report questionnaires are used, instead of using an independent party to collect data, participants may be prone to alter their answers (Sekaran, 2003). This may be intentional or non-intentional. Often the way that people perceive themselves can vary from their actions. However, since the data can be collected from participants’ recollection (except for the analytical- and creative-thinking measures), it was the only acceptable instrument in this study. The participants were asked to remember environmental and motivational factors as well as activities from their adolescence. The accuracy of these perceptions may be uncertain.

For many years there has been controversy among statisticians regarding the use of statistical significance and practical significance in the reporting of research findings. Although it has become common analytical practice to require statistical significance to be obtained first, and then for practical significance to be measured (Henson, 2006; Thompson & Snyder, 1997), there are some researchers who consider practical significance as a primary tool of analysis (Carver, 1978; Hubbard & Lindsay, 2008; Lambdin, 2012). As early as the 1960s the use of null-hypothesis based statistical methods in psychological research was being questioned (Bakan, 1966; Clark, 1963, Shulman, 1970). In 1978, Carver (1978) called for educational researchers to stop using statistical significance tests referring to them as “useless” and “harmful because [they are] interpreted to mean something [they are] not” (p. 392). The current trend against statistical significance suggests relying much more heavily on practical significance,
especially effect sizes (Henson, 2006, Thompson, 1999). The current APA Publication Manual (2010) plainly states that this controversy is outside the scope of a publication manual, simply stating that the emphasis or de-emphasis of statistical significance lies with each journal editor. The author of this study has chosen to de-emphasize statistical significance, primarily relying upon effect size to illuminate the practical significance of the group differences on various measures and differences among measures within groups.

The most severe limitation in this study was the small sample size for the quantitative data. The representativeness is partially achieved, although not at the desirable level due to the small sample size, since all graduate students from the participating departments were solicited for participation. The study received low to moderate levels of responses to the call for participation (excluding the education majors, who were from a very large department). Although these rates seem low for research, they might be indicative of the educational standing of the participants, i.e., graduate-level students. Many of the graduate students that did not participate made statements about their schedules and about being too busy, indicating their workload as extremely demanding. When working with smaller departments, there came a point when it became clear that the students who had not volunteered were not going to volunteer, regardless of how many times they were asked. In future extensions of this research, expanded samples of talented individuals should be gathered. One method of procuring an expanded sample would be to use students from other universities, varying in their rank of quality and reputation. This would not only solve the sample size issue, but would also lend to an
increased level of generalizability for the results of the study. The replication of the current results would serve to increase the confidence in the current findings.

Grouping participants from different programs into three major areas helped to provide samples that represent the three domains (science, art, and education) (Biglan, 1973) as well as reasonable numbers of participants in each group. However, this grouping also limited findings. For example, in science, physics and chemistry majors were grouped together, thus the differences between them were lost in the analysis. Future studies should further examine these subgroups to determine if differences exist in their profiles. By isolating the majors, some compounding effects of grouping would be eliminated.

Other talent domains such as business, engineering, or different forms of arts should also be analyzed to further understand the complex nature of domain-specific talent development. In addition, other dimensions could be added to the research questions. Tests could include questions of biological (familial) talent tendencies, personality factors beyond motivational attributes, or domain-specific creative-thinking ability tests.

Education majors at the master’s level in general are different from the other two majors. Graduate students in science and art were viewed as having developed their talent at certain levels in their developmental trajectory. However, due to the large number of master’s students in education (i.e., admission to the program is not as selective as the other fields), the same claim is hard to make. In order to find the education majors who can represent talented teachers, participants were solicited from a pool of graduate students highly decorated as excellent teachers by a professor in education who is
familiar with the education programs. These students did not have undergraduate education degrees but had shown their excellence in the graduate education program. Future studies with the individuals who became teachers through more standard credential procedures are warranted.

Finally, some of the instructions for the ATTA creativity test, non-verbal section, were not clear to some participants. Several participants asked for clarification about how and where they could draw pictures. Some participants drew the pictures in wrong locations, which initially affected their score. These scores were later recalculated, against the suggestions in the scoring instructions, as the researcher and the second coder agreed that pictures in the wrong location should be counted. The adjusted scores might have been influenced in either a positive or negative way. In future research, use of the ATTA should be evaluated.
Appendix A

Self-Assessment Questionnaire: Motivation (SAQ-M; Hartzell & Hong, 2008a)

Your Name:

Directions: A number of statements which people have used to describe their HIGH SCHOOL experiences are given below. Please read each statement and choose the option that best describes YOUR HIGH SCHOOL EXPERIENCE. (1 = Not true at all; 2 = Slightly true; 3 = Often true; 4 = Very true)

<table>
<thead>
<tr>
<th>When I was in High School...</th>
<th>Not true at all</th>
<th>Slightly true</th>
<th>Often true</th>
<th>Very True</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mastering a concept or technique associated with learning was important to me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I worked hard to do well even if I didn’t like the task.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. I thought that what I was good at was valuable to society.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Deciding on a career path to follow was difficult...</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. I always managed to solve difficult problems if I tried hard enough.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. Avoiding receiving low grades on tests or projects was important to me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. I put forth my best effort on tasks.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. I wanted a career where I could earn a large salary.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. I knew what I wanted to do for a career.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. It was easy for me to stay focused and accomplish my goals.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. Doing better than my classmates was important to me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. I worked as hard as possible on all tasks.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. I wanted a career that would make me happy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. I felt compelled to study in the area I was good at.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. I was confident that I could handle unexpected situations effectively.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not true at all</td>
<td>Slightly true</td>
<td>Often true</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>----------------</td>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>16. Receiving good grades was important to me.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17. I kept working even on difficult tasks.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18. I wanted a profession where there would be many positions available for me after I graduated.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>19. I thought that I could have excelled in several different areas.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>20. I could solve most problems if I invested the necessary effort.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>21. Learning was more important to me than grades.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>22. I didn’t give up even if the task was hard.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>23. I wanted to be respected after I graduated.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>24. I thought that contributing to the general knowledge about a topic would bring me joy.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>25. When I was confronted with a problem, I usually found several solutions.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>26. I was more focused on learning than on earning high grades.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>27. I concentrated fully when doing a task.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>28. I wanted to succeed in my career choice.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>29. I enjoyed learning about topics that I was good at.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>30. No matter what came my way, I was usually able to handle it.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>31. I continued to study subjects after assignments were completed, because I was interested in them.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>32. I worked hard on a task even if it did not count.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>33. I expected to be paid well after I graduated.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
When I was in High School…

<table>
<thead>
<tr>
<th></th>
<th>Not true at all</th>
<th>Slightly true</th>
<th>Often true</th>
<th>Very True</th>
</tr>
</thead>
<tbody>
<tr>
<td>34. I thought that I could change my college major, if I did not like the first one I chose.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>35. I spent many hours on assignments to earn the grade I wanted.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>36. I wanted a career where I could help people.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

37. What were the three most important reasons why you have chosen to follow your current path of study?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Thank you!
Appendix B

Self-Assessment Questionnaire: Social and Environmental (SAQ-SE; Hartzell & Hong, 2008b)

**Your Name:**

**Directions:** A number of statements which people have used to describe their HIGH SCHOOL experiences are given below. Please read each statement and choose the option that best describes YOUR HIGH SCHOOL EXPERIENCE. (1 = Very unlike my experience, 2 = Rather unlike my experience; 3 = Somewhat like my experience; 4 = Much like my experience)

<table>
<thead>
<tr>
<th>School</th>
<th>Very unlike my experience</th>
<th>Rather unlike my experience</th>
<th>Somewhat like my experience</th>
<th>Much like my experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>When I was in high school...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. My teachers thought that I was gifted.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. There were teachers that I remember helping and encouraging me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. I participated in my school's Gifted and Talented program.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I was enrolled in advanced classes in subjects where I was talented.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. My school's administration helped me to succeed at school.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. There were classes offered in subjects I was interested in.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. There were groups or clubs for people with similar interests as me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. I had a mentor (teacher or counselor) who helped me at school.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. My teachers gave me advanced assignments as compared to those given to my classmates.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Going to my school helped to develop my interests.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. I was enrolled in honors classes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. What else did your school do to help you develop your interests and talents?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family</td>
<td>Very unlike my experience</td>
<td>Rather unlike my experience</td>
<td>Somewhat like my experience</td>
<td>Much like my experience</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------</td>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>When I was in high school...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. My parents supported my interests. ...............</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. I had other siblings who are similarly talented. ..................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. I had some of the same talents as my parents.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16. My parents disagreed with my choice to pursue my interests. .......................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17. My family was proud of my achievements. ...</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>18. My parents wanted me to study a different area than what I was interested in at college.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>19. My family did not think that I would succeed at what I was interested in. ...............</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>20. At least one of my parents, who is talented in the same way that I am, was successful. ......</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>21. My parents sent me to various programs (camps, summer programs, etc) to develop my interests. ..................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>22. My parents never understood why I liked to spend time developing my interests. ...............</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>23. My parents bought me supplies to help me pursue my interests.........................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>24. What else did your family do to help you develop your interests and talents?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Other Environmental Influences**

<table>
<thead>
<tr>
<th>When I was in high school...</th>
<th>Very unlike my experience</th>
<th>Rather unlike my experience</th>
<th>Somewhat like my experience</th>
<th>Much like my experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>25. My friends were about as smart as I was. ...</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>26. People made fun of me for being smart. .....</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>27. I was one of the popular people. ...............</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>28. It was easy for me to make new friends. .......</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>29. When meeting new people, I did not want them to know how smart I was. ..................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>30. My friends supported me when I was expressing my interests. ......................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>31. I did not know how to socially interact with my peers. .............................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>32. Being academically talented was considered a good thing in my neighborhood. ...........</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>33. I had very few friends during my high school years. ..................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>34. I acted less talented than I was to “fit in” . .....</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>35. I had a mentor that I met outside of school. ...</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>36. My relatives and friends outside of school thought that I was talented. ...............</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>37. My relatives and friends outside of school encouraged me to pursue my interests. .........</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>38. I was known as one of the “smart kids”. ........</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>39. My friends pressured me not to complete assignments. ...................................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>40. I studied with my friends after school. ........</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

41. What else did your friends do to help you develop your interests and talents?

Thank You!!!
Appendix C

Demographics Questionnaire

DEMOGRAPHIC INFORMATION SHEET

The following information will be used to describe characteristics of respondents to this survey in a summary form. The information provided is confidential. PLEASE ANSWER EVERY ITEM.

Your name: __________________________

1. Gender (check): [ ] Female [ ] Male


3. Graduate Program: __________________________

4. Number of years of Graduate School Completed: _______ Current Graduate GPA: __________

5. Did you take the GRE exam: [ ] Yes [ ] No

   If yes: What was your verbal score? __________

   What was your quantitative score? __________ [separate scores will be helpful]

6. What subject area is your Bachelors' Degree in? __________________________

7. When did you graduate with your Bachelors' Degree? ________ Undergraduate GPA: __________

8. What year did you graduate High School? __________

9. Did you attend High School in the USA? __________

   If not, where did you attend High School? __________________________

10. Do you consider yourself talented? (Circle)

   1  2  3  4  5  6  7

   Not at all Somewhat Moderately so Very much so

   Why? __________________________

11. Please list all accomplishments (e.g., projects, publications, exhibits, etc.) during your graduate years. List only the items in the area of your graduate program. For each item, please briefly describe the characteristics of activities and accomplishments.

   __________________________

   __________________________

12. Please list all other accomplishments during your graduate years. List only the items in the area outside of your graduate program. For each item, please briefly describe the characteristics of activities and accomplishments.

   __________________________

   __________________________

   Thank you very much for participating in this research!

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Appendix D
Structured Interview Document

1. When you were in high school, what was your primary goal in school?
   1.1. (If no response) Do you think you have a goal or objective that you wanted to achieve during high school?
      1.1.1. (If no response) For example, which was more important to you, learning or receiving high grades, and why?

2. When you were in high school, were you presented with tasks that were difficult for you to complete?
   2.1. What did you do when/if you did encounter these tasks?

3. When you were choosing a field (major) to study during high school, were you more concerned with finding a path that would make you happy, a path that would lead to a well paying job, or a path that would lead to public recognition?
   3.1. Why was your option more important to you than the rest?

4. When you were in high school, how interested were you in your current field of study?
   4.1. Were there other areas that you were equally or more interested in?
   4.2. What were they?
   4.3. What made you choose your current field of study instead of these other fields?

5. When you were in high school, how confident were you in your ability, in general, to deal with problems or unexpected situations?

6. What do you think was the most important thing that your high school did to help you develop your interests in the area you are pursuing now?
   6.1. (If no response) How do you think that your high school and/or teachers influenced you in developing your interest and ability in [physics; music…]?

7. What do you think was the most important thing that your family did to help you develop your interests in the area you are pursuing now?
   7.1. (If no response) How did your home environment persuade or dissuade you from following your interests?
   7.2. (If no response) For example, your parents, siblings, family income, and so on.

8. Do you consider your friends in high school to have been positive, negative, neutral influences on the development of your interests?
   8.1. (If positive or negative) What did they do to influence your learning?

9. Did you think that you were intellectual during high school?
   9.1. Why?

10. Did you think that you were creative during high school?
    10.1. Why?

11. Tell me out-of-school activities you engaged in during high school.
    11.1. Did you enjoy these activities?
    11.2. Why?
12. Tell me out-of-school activities that you wanted to participate in but didn’t or couldn’t.
   12.1. What held you back from participating?
13. Were/are there any other fields that you considered going into before you decided on [physics, music...]?  
   13.1. What were they?  
   13.2. Why didn’t you pursue?
14. When deciding to follow your current major, what were the most important reasons for your choice?
15. Since starting graduate school, have you done anything that you consider to be an accomplishment in your major area?
16. Since starting graduate school, have you done anything that you consider to be an accomplishment in other areas?
17. If you had a chance to choose your career path again, would you be in this field?
   17.1. Why?
18. (For only non-education participants) If you had a chance to be a teacher of elementary or secondary level students, would you take it?  
   18.1. Why or why not?
19. Why are you pursuing a Graduate Degree?
Appendix E

Testing Instructions

Help yourselves to Pizza, sodas, and deserts, but please make sure that you are ready to begin at _____pm.

(Participants will be filtering in and eating/socializing)

OK, if we could all get rid of our trash and find a seat that would be great.

(wait for room to settle)

Good afternoon/evening. First of all, I would like to thank you for helping me by participating in this research. I have placed two sharpened pencils at each of your desks. If you need an additional pencil during the research please raise your hand. We are going to start with a standard release form that tells you a little about this research. It basically states that I am conducting research on cognitive and developmental aspects of graduate students, and that by signing the form you agree to participate. If at any time you no longer wish to continue with this research you can stop and exit the room, although, I hope that this does not occur for anyone. Please read-over and sign the form, and I will come by to collect it. If you would like a copy of this document I have extras here at the front.

(Hand out the consent form.)

If everyone is finished reading over the consent form, I will come by to pick them up.

(Pick-up consent form)
Now that we have completed that, I am going to pass out the first test and reading the instructions. Please do not open them until I say to. Fill out the information on the front of the test booklet when you receive it.

(Pass out ATTA booklets)

I will read the instructions now, so that there is no confusion about what to do on this test.

(Read the instructions)

“The test you are about to take involves three activities. One calls for verbal responses and the other two calls for figural responses. The activities will give you a chance to see how good you are at thinking up new ideas and solving problems. They will call for all of the imagination and thinking ability you have.

For each of the three activities, I will read – as you read along with me – the directions in the test booklet. After this you will be given 3 minutes to respond.”

Are there any questions?

“Open your booklet and fold the cover back to page one so that only Activity #1 can be seen.”

(Pause)

“I will now read the instructions for Activity #1 and you may follow along with me by looking at your test booklet.”

(Pause)

“Just suppose you could walk on air or fly without being in an airplane or similar vehicle. What problems might this create? List as many as you can.”

(Pause)
“You have 3 minutes to respond to this activity. Do not continue to the next activity until I tell you to do so. Ready? Begin.”

(Wait exactly 3 minutes.)

“Stop.”

“We are now ready for Activity #2. Turn the page and fold it back so that only Activity #2 on page two can be seen.”

(pause)

“I will now read the instructions for Activity #2 and you may follow along with me by looking at your test booklet.”

(Pause)

“Use the incomplete figures below to make some pictures. Try to make your pictures unusual. Your pictures should communicate as interesting and as complete a story as possible. Be sure to give each picture a title.”

(Pause)

“No credit will be given for this activity unless the two incomplete figures are used.”

(Pause)

“You have 3 minutes to respond to this activity. Do not continue to the next activity until I tell you to do so. Ready? Begin.”

(Allow exactly 3 minutes.)

“Stop.”

“We are now ready for Activity #3. Flip over your booklet to page three so that only Activity #3 can be seen.”
“I will now read the instructions for Activity 3 and you may follow along with me by looking at your test booklet.”

“See how many objects you can make from the triangles below. Just as you did with the incomplete figures. Remember to create titles for your pictures.”

“No credit will be given for this activity unless the triangle figures are used.”

“You have 3 minutes to respond to this activity. Ready? Begin.”

“Stop. The test is completed. Close your booklets and make sure the identifying information on the cover has been completed.”

I will come by to collect each of your booklets. Please make sure that you name is on the front.

Let’s take a break for a few minutes. If anyone needs to use the facilities, please go and come straight back so that we can continue.

Now it is time for questionnaires. There are 4 questionnaires in each packet. Before beginning each questionnaire please read the instructions at the top of the page. When you complete one, please just continue on to the next one. When you are finished please wait quietly until everyone else is finished.
While progressing through the items you may notice that some of the questions seem quite similar. Please don't be concerned about similarity but just answer all items. Also, some of the items will ask you to remember back to High School. I understand that it may be difficult to remember back that far, but please try your best to remember and respond to the items.

You can begin your questionnaires as soon as you receive them.

(Pass-out surveys)

It looks like everyone has completed. Is there anyone still working on their surveys?

Excellent, I will come by to pick-up your packets. Please make sure that your name is on it.

(pick-up surveys)

I want to extend my heart-felt thanks to you for helping me with this research. If you have any questions you can call me at the phone number listed on the board behind me.

Have a wonderful evening. Thank you.
References


Minzesheimer, B. (1998, April 30). Irving enjoys wrestling with strong-willed “Widow,” *USA Today*, p. 4D.


Thompson, B. (1999). If statistical significance tests are broken/misused, what practices should supplement or replace them? *Theory & Psychology, 9*, 165-181.


CURRICULUM VITAE

NAME: Stephanie A. Hartzell

HOME ADDRESS: 8513 Timber Pine Ave.
Las Vegas, NV 89143
P: 702-257-0640
C: 702-300-8197
E-mail: StephanieHartzell@hotmail.com

EDUCATIONAL HISTORY

2012 (Anticipated) Ph.D. Educational Psychology, University of Nevada Las Vegas. Specialization in Research Methods with an emphasis in Educational Evaluation. Advisor: Dr. Eunsook Hong.

2001 MBA, University of Nevada Las Vegas. Concentrations in Counseling and Finance.

1999 B.S. Physics, Utah State University. Concentration in Operations Research. Advisor: Dr. Jan Sojka.

HONORS AND AWARDS

Senior Physics Research Award, Utah State University, 1999.


PROFESSIONAL HISTORY

Teaching Experience

2005-2011 Instructor, University of Phoenix, Business Department. Teach undergraduate business research methods and statistics courses and tutor graduate and undergraduate students in statistics, Las Vegas, NV.

2007, 2008 Instructor, Introduction to Descriptive Inferential Statistics, Educational Psychology Department, UNLV, Las Vegas, NV. Teach graduate introductory statistics course.
2003-2004 *Instructor*, Beginning Algebra, Mathematics Department, UNLV.
1999-2000 *Graduate Assistant*, Department of Management, UNLV.

1998-1999 *Computer Lab Assistant*, Education Department, Utah State University. (Also 1997 summer)

**Other Professional Experience**


2000-2008 *Product Specialist*, Telkonet/Smart Systems International, Las Vegas, NV. Create statistical models, complete engineering tests, conduct product quality assurance testing, design marketing materials, and perform other business consultant types of activities.

1995-1996 *Student Intern*, NASA Goddard Space Flight Center, Greenbelt, MD. (2 Summers)

**SCHOLARLY ACTIVITIES**

**Refereed Publications**


**Presentations**

annual meeting of the American Educational Research Association, New Orleans, LA.


Hartzell, S. A. (2002) Sales and Installation Techniques for SmartSystems. Course was taught over several days to numerous classes while working for Smart Systems International, Las Vegas, NV.


Grants and Scholarships

2011 Graduate and Professional Research Grant, University of Nevada, Las Vegas, $600.

1996 Western Maryland College (now McDaniel College) – Maryland High School Valedictorian Scholarship, Full Tuition (aprx. $25,000 per year).

1996 Aid Association for Lutherans Scholarship, $4,000.

1996 Marshal Management Association Scholarship $1,500.

Professional Memberships

American Educational Research Association (AERA)
American Psychological Association (APA)
Association for Psychological Science (APS)
TEACHING

Courses Taught

*Introduction to Descriptive Inferential Statistics*, Educational Psychology Department, University of Nevada, Las Vegas. Spring Semester, 2007, Summer Semester, 2008. Graduate level introduction to descriptive and inferential statistics. This course covers topics such as measures of central tendencies, regression, t-tests, standard scores, and ANOVAs. Students in this class included Educational Psychology, Nursing, Business, and Curriculum and Instruction majors. In-class and online versions.

*Business Research and Statistics*, Department of Business, University of Phoenix. Rotating five week sessions Fall 2005 through Summer 2011. Undergraduate introduction to research methods and statistics course for business majors.

*Business Statistics*, Department of Business, University of Phoenix. Rotating five week sessions Fall 2005 through Summer 2011. Undergraduate advanced statistics course for business majors, covering t-tests to regression and basic non-parametric methods.

*Beginning Algebra*, Department of Mathematical Sciences, University of Nevada, Las Vegas. Fall Semester, 2003, Spring Semester, 2004. (2 sections each semester) Course was the non-credit equivalent of entry-level math proficiency.

SERVICE

2000  *Board Member*, Business Graduate Association, UNLV.