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The Phenomenon of Abstract Cognition Among Scholastic Chess Participants: A Case Study

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The Phenomenon of Abstract Cognition Among Scholastic Chess Participants:

A Case Study

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ABSTRACT

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A qualitative investigation was conducted to explore the phenomenon of abstract cognition among a purposive sample of 5 secondary scholastic chess club participants. The case study enabled the researcher to explore the faculties of abstract cognition among students of contrasting skills and abilities in playing chess. The study also allowed for the consideration of potential visual-spatial, logical, academic, social competency and life benefits of chess play. Through analysis of interviews, chess simulations, blindfold chess play, and narration of chess lines and sequences, the investigator was able to extract meaning and code schemata into a holistic understanding of the phenomenon of abstract cognition within the context of Piaget's Formal Operations Stage.

Scholastic chess systematically engages the student in a stimuli-enriched environment in which the participant must exercise optimal cognitive control in processing and anticipating chess lines and sequences, thus facilitating the manifestation and phenomenon of abstract cognition. Abstract cognition as a phenomenon may elicit increased academic, scholarly, and life potential. Participation in scholastic chess may produce both scholarly and critical thinking individuals. Suggestions for future research include continuing qualitative research in the area of abstract cognition among chess players and developing a stronger understanding of cognitive growth in students.

DEDICATION

For C.J.L and J.H.L.

Though much is taken, much abides; and though

We are not now that strength which in old days

Moved earth and heaven, that which we are, we are,

One equal temper of heroic hearts,

Made weak by time and fate, but strong in will

To strive, to seek, to find, and not to yield.

- ALFRED, LORD TENNYSON

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CHAPTER 1

INTRODUCTION

Abstract cognition exists as a phenomenon within both natural and artificial domains such as the abstract strategy game of chess. Scholastic chess systematically engages the student in a competitive environment in which the student must call upon higher-order cognitive skills, which may increase abstract cognitive ability. Chess has been found to develop critical thinking skills and abilities that can be used in other areas of students' lives (Susan Polgar Foundation, 2013). Chess research identifies chess instruction to be a catalyst of improved spatial ability, logic, cognitive ability, visualization, problem-solving capacity, and abstract thinking ability, and chess may increase the social competence of scholastic chess participants (Berkley, 2013; Bilalic, 2013; Bilalic, McLeod, & Gobet, 2007; Celone, 2001; Hong & Bart, 2007; Martinez, 2012). Chess may be used by educational agencies throughout the global learning community to meet the varying critical thinking and problem-solving requirements of an amalgam of low-achieving, mainstream, and gifted students (García, 2008; Nippold, 2009).

Students are able to exhibit abstract thinking skills similar to chess masters through the active narration of chess lines and sequences. Students realize that they too can achieve and exhibit the abstract thinking ability similar to that of chess masters. If the game of chess is a medium of cognitive and behavioral change such as cognitive growth, then scholastic chess can theoretically increase cognition within the realm of Piaget's Formal operations stage (Horgan, 1986).

The findings of this study will support or refute the arguments of international chess masters by providing scholarly evidence in support of chess as a means to increase one's abstract cognition. The research findings will enhance the body of research on student abstract cognition

and strengthen the body of clinical qualitative research.

Students can improve both their cognitive and chess abilities through scholastic chess (Brandefine, 2005; Celone, 2001; Horgan, 1986; Horgan & Morgan, 1988; Storey, 2000). Higher order cognitive skills are open to enhancement through chess participation and "chess skill rating is a key predictor for the improvement of student cognitive skills" (Hong & Bart, 2007, p. 89). Students may increase their cognitive, behavioral, intellectual, and scholarly merits through their participation in the royal abstract strategy game of chess (Brandefine, 2005; Celone, 2001; Horgan, 1986; Horgan & Morgan, 1988; Storey, 2000). Abstract cognition as a phenomenon may elicit increased academic and scholarly potential for those engaged in chess play.

Statement of the Problem

Abstract cognition as a phenomenon is a multifaceted educational, cognitive, and behavioral domain for investigation. Educators and neuroscientists are seeking ways to increase abstract cognitive ability among students; however, there is not an identifiable best practice (Hearst & Knott, 2009; Horgan, 1986; Mechner, 2010). The problem is the nature of abstract cognitive phenomena and its transferability to the school level as a means to increase student cognition. The researcher was tasked with determining if scholastic chess affects the phenomenon of abstract cognition as defined by Piaget's Formal operations stage of thinking.

The effects of chess on academics, life, and cognitive abilities have received little scholarly attention and mainstream publicity (Fergusson, 2003). The unfavorable perceptions of educators and policy analysts reflect the criticisms of chess research as being overly anecdotal, riddled with sampling error, and biased, and critics cite the nature of chess to be an exclusionary practice (Parr, 2011). The general idea of chess as a tool for increased abstract cognition and

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student achievement is evidenced by both qualitative and quantitative research (Aciego, 2012; Linhares, Freitas, Mendes, & Silva, 2012). There can be distinctly different findings or a disjoint of scholarly opinion when comparing the findings between qualitative and quantitative studies (Berkley, 2013; García, 2008). For example, García and Berkley found no statistical significance between students who participated in chess and students who did not participate in chess; however, the qualitative phases of their mixed methodology offered contrasting conclusions about the cognitive effects of chess participation. Quantitative research does not lead to a consensus concerning such an apparent relationship between chess and increased cognitive ability; whereas qualitative research overwhelmingly supports chess as a stimulus for abstract cognition and learning. Quantitative studies determined that there is no statistical significance of any distinction between experimental groups of students participating in scholastic chess and control groups (García, 2008). These conclusions and inferences mirror those of other quantitative experiments but not the entirety of quantitative research. Sequential explanatory mixed-methods studies were tasked with determining whether the game of chess can be used as an educational tool to improve critical thinking skills of students, thus improving student achievement. The qualitative segments of the research studies produce data in support of chess as an educational tool to increase student achievement (Berkley, 2013). Chess instruction does not markedly improve critical thinking ability (Berkley, 2013; García, 2008). There is research that details positive correlations between critical thinking and chess achievement, although such correlations are considered weak or statistically insignificant (Berkley, 2013). However, mixed-methods and qualitative research produce findings that show there are many relationships between chess, abstract thinking, and learning (Berkley, 2013). Scholastic chess systematically engages students in a competitive environment in which each participant calls

upon higher-order cognitive skills, thus increasing abstract cognition (Susan Polgar Foundation, 2013).

Chess improves cognitive ability, coping and problem-solving capacity, and the socioaffective development of K-12 students who participate in scholastic chess programs (Horgan, 1986). Cognitive growth relates to both an increase in chess nomenclature and skill in addition to an increase in cognitive demand during scholastic chess participation as evidenced in quantitative experiments (Bilalic et al., 2007; De Bruin, Rikers, & Schmidt 2007; Hong & Bart, 2007). The effect of chess upon learning is difficult to quantify; however, qualitative measures provide support for chess as a mode of increasing abstract cognitive ability. The case study being used in this investigation will allow the researcher an in-depth opportunity for exploration of the relationship between chess and the phenomenon of abstract cognition by implementing interviews, simulations, observations, and iterative coding.

The purpose of this case study is to explore the phenomenon of abstract cognition among scholastic chess participants at MHHS. Abstract cognition is defined as the Formal Operations Stage of cognitive development (Piaget, 1927) whereby chess participants demonstrate the ability to conceptualize hypothetical scenarios and ideas. Students will describe the process of anticipating both outcomes and dilemmas as they generate solutions in other areas of their lives.

Research Questions

1. How do scholastic chess players describe their experiences in the MHHS Chess Program? (Central Research Question)

2. How do scholastic chess players demonstrate their ability to conceptualize hypothetical scenarios and ideas?

3. What are the cognitive processes that scholastic chess players use to anticipate potential

outcomes?

4. How do scholastic chess players describe the role of chess in their ability to anticipate dilemmas and generate solutions in other areas of life?

Significance of the Study

This research is significant in that it strengthens the body of knowledge surrounding abstract cognition. The research findings will further the field of educational research on student cognition and enhance the already rich body of clinical qualitative methodology. This study directly addresses the need for scholarly research in regard to chess and abstract cognitive processing. This research may serve as a foundation that stands as the methodological underpinning of subsequent research and explorative qualitative studies in the area of abstract cognition. This case study examines the reasoning and cognition experienced by the student participants.

There is much anecdotal and ad-hoc evidence supporting the idea that chess is a catalyst of abstract thinking phenomena and responsible academic and life decisions (Liptrap, 1999; Parr, 2011). An additional significance of this study is in the systematic evidence from which meaning was extracted while investigating the phenomenon of abstract cognition among student chess participants.

Definitions of Terms

The following terms are defined for the purpose of this study.

1. Abstract cognition: Evidenced by forward search, perceptual processing and pattern recognition, as defined in terms of Piaget's Formal Operational Thinking Stage (Piaget, 1927).

2. Chunking: Defined as the degree to which information is grouped into explicitly labeled

categories of distinct valence (Wegener, 2001).

3. Conceptual categorization: The description of perceptual information into conceptual form, particularly the paths objects take and their interactions (Mandler, 2000).

4. Critical thinking: Defined as the use of basic thought processes to solve problems, to analyze arguments, and to generate insight into specific meanings and interpretations (Thorpe, 1989).

5. Formal operations stage: The developmental stage that is evidenced by characteristics of advanced reasoning, creativity, conceptualizing external concepts, and abstract thinking (Piaget, 1927).

6. Perceptual processing: A type of object categorization process in which an individual computes the perceptual similarity of one object to another by creating schemas of what objects look like (Mandler, 2000).

Limitations and Delimitations

Contextual consideration was integral to understanding the phenomenon of abstract cognition and was supported with case study methodology (Yin, 2003, 2009). Case study methodology offered distinct advantages as the researcher explored the phenomenon of abstract cognition and was not limited by any profound limitation or delimitation (Yin, 2003, 2009). However, there are weaknesses associated with case research where one weakness lies within the open-ended nature of qualitative research (Kohlbacher, 2006; Patton, 2002; Sieber, 2013). Case study researchers can enter into dialogue with interviewees with little control over the topics. The limitations or weaknesses cited in qualitative studies relate to the exploratory and emergent nature of qualitative research (Kohlbacher, 2006; Patton, 2002; Sieber, 2013). Qualitative research implements interviews where respondents vocalize their cognition and

conceptualizations (Sieber, 2013). This study's qualitative approach allowed the researcher to provide a space for participants to tell their stories, and in that telling, the researchers could have been taken to places for which they were not prepared (Sieber, 2013). The investigator adhered to responsible and ethical research protocols requiring planning for an emergent research question that could produce ethical issues not previously identified (Sieber, 2013).

Sieber (2013) lists a second weakness of qualitative research design associated with case study research, namely, associated emotionality. Associated emotionality oftentimes manifests into overly intimate and dangerous experiences for both the researcher and the participant. Emotionality can disguise itself as subjectivity that limits credibility (Sieber, 2013). Feelings and internalized beliefs were bracketed by the researcher to prevent emotionality from threatening the validity and generalizability of this study.

There are two limits associated with exploring phenomena, "The occurrence of mental facts that do not belong to the phenomenal scene (habits, forgetting) and the actual impossibility of distinguishing which aspects of a mental fact, such as percept, play the role of causes and which those of effects" (Vicario, 1993, p. 197). The researcher made artifact each researcher-participant interaction with detailed and descriptive notes such as observations and transcriptions of documented dialogue to limit the role of percept. The researcher used an expert scholarly peer to simultaneously analyze and interpret the textual data.

Baxter (2008, p. 554) states: "A hallmark of case study research is the use of multiple data sources, a strategy which also enhances data credibility." The opportunity to gather data from various sources is extremely attractive because of the associated rigor, but the collection of overwhelming amounts of data requires attentive management and analysis of the data (Baxter, 2008).

The chosen research design of this study only reveals information on a specific group of students in a specific program, thus reducing broad transferability for the study. It is possible that the small group consisting of both a low and high-achieving student, an At-Risk (academic failure) student, a gifted student, and both an economically advantaged and disadvantaged student, may not have produced as complete an understanding of the neuro processes the research was to understand.

Overview of the Study

The focus of the research effort manifests from the central research question, "How do scholastic chess players describe their experiences in the MHHS chess program?" The participants' thick and rich description of their experiences allowed for theoretical insight into the phenomenon of abstract cognition. This study includes five chapters. Chapter 1 establishes the need and basis for this research study by including an introduction to the study, a problem statement, the research questions, definitions of relevant terms, and the limitations and delimitations of the study. Chapter 2 is a review of the literature that contains the emergent themes of the supporting scholarly research relating to chess playing and cognition. Chapter 3 is a presentation of the research methodology and design. Chapter 4 is a presentation of the interpretation of the data, the coding of the descriptive data, and the findings of the study. Chapter 5 is a summary of the findings, conclusions, implications for practice, and recommendations for further research.

CHAPTER 2

REVIEW OF LITERATURE

Introduction

There is a growing body of evidence in support of chess as a medium conducive to increasing cognition and intelligence among K-12 students. The salient characteristic of chess is two-part, namely the unintelligible enormity of possible combinations and its ability to effect an elegant and refined cognition (Berger, 1989; Hearst & Knott, 2009; Mechner, 2010). Shannon (1949) was the first to assign a finite value to the combinatorial complexity of chess. There are more possible chess configurations than atoms within the Earth's observable universe (Shannon, 1949). Chess is a burgeoning research domain for both educators and cognitive researchers.

Berger (1989, p. 2) describes chess as a "Complex and knowledge-rich domain," where "... It is no accident that cognitive psychologists have repeatedly used the game of chess to study problem solving and knowledge organization." The qualitative exploration and discovery of the phenomenon of abstract cognition associated with chess as an abstract domain is detailed and documented in this particular study. Chess is considered to be the drosophila of cognition research and psychometrics (Chase & Simon, 1973; Mechner, 2010; Van der Maas & Wagenmakers, 2005). Chess can serve as a useful laboratory model for cognitive skill research and the exploration of abstract cognition among scholastic chess participants (Mechner, 2010).

Much of the literature equates an increase in cognitive ability with a corresponding increase in both the social and the academic performances among the world's primary and secondary schools (Aciego, García, & Betancort, 2012; Horgan, 1986; Scholz, 2008). The fruit of the existing scholarly work is a research-based call to reflect chess in national and international school curricula (Brandefine, 2005; Celone, 2001; Horgan, 1986; Horgan &

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Morgan, 1988; Storey, 2000). Chess develops the skills necessary to deal with personal and

academic complexities, thus becoming an invaluable tool for learning in the public schools

(Schmidt, 1982). Chess is used as an educational tool to cultivate higher order thinking skills, to

prepare students for an increasingly complex future, and to increase social skills and self-efficacy

(Barrett, 2010; Celone, 2001; Hong & Bart, 2007; Horgan, 1986; Scholz, 2008)

The ideas linking chess to changes in abstract thinking, cognitive developments, and

behavior in students has been identified in research over many years. Horgan (1986, p. 12)

states:

> Teaching children to perform a complex task like chess may give them problem-solving
>
> advantages later - at least with chess, possibly with other similar situations. Children
>
> who learn to use feedback successfully and to take a global perspective may be able to
>
> maintain that approach while improving their more analytic skills.

Many researchers aim to answer specific questions concerning chess as a gatekeeper to abstract

phenomena and increased cognitive capacity. Positive benefits of chess play are identified as

marked increases in abstract cognition and advance problem solving ability (Aciego et al., 2012;

Berkley, 2013; Celone, 2001). This study continues the traditions of case study research

connecting chess to student abstract thinking, cognitive development, and behavior.

Schools may benefit from implementing scholastic chess programs as chess is found to

increase one's academic, societal, and life success (Celone, 2001; Horgan, 1986). Artise (1973,

p. 1) states: "... The game of chess makes one of the most important contributions to the field of

education. Inherent in it is the basic principles of psychological learning theory: memory,

pattern recognition, decision-making, and reinforcement." Aciego et al. (2012), Berkley (2013),

Hong and Bart (2007), and Scholz (2008) identify questions central to chess research: "Does

chess make students smarter?", "What are the effects of a chess program on abstract reasoning and problem solving?", "What are the benefits of chess for the intellectual and social-emotional enrichment in school children?", "What is the impact of chess instruction on the critical thinking ability of mathematics students?", "What are the effects of scholastic chess club participation on the achievement of Hispanic students?", "What are the effects of chess instruction on At-Risk students?", and "What is the impact of chess training on mathematics performance and concentration abilities of children with learning disabilities?" Such questions manifest from 20th century ideas in which educators, parents, and chess experts maintain that chess participation improves mental abilities, abstract cognition, and problem solving abilities (Celone, 2001). If abstract cognition exists as a phenomenon of scholastic chess participation, then schools engaged in the support and development of a comprehensive chess program may demonstrate increased levels of academic, societal, and life success among students (Celone, 2001).

The cognitive demands associated with the chess opening, the middle game, and end game were investigated by observing over-the-board and blindfold chess simulations (Horgan, 1986). Both qualitative and quantitative studies demonstrate the dangers of focusing on a single specific factor from several real-world situations where many interconnected factors operate (Berkley, 2012; Bilalic et al., 2007). Berkley (p. 2) states:

> For the results of the qualitative phase of the study, the students perceived that there are
> many relationships between chess, critical thinking, and developmental
> mathematics…The students perceived that playing chess can improve critical thinking.

The researcher concludes that that there are many mutually dependent relationships among abstract cognition as a phenomenon and chess club participation (Berkley, 2012; Bilalic et al., 2007). Secondly, the review of the literature identifies a Piagetian framework as the

premier model of investigation the phenomenon of abstract cognition among chess club players (Christiaen, 1976; Horgan, 1986; Horgan & Morgan, 1988). The third central theme developed from a review of the literature reflects the idea that participation in scholastic chess both catalyzes and synthesizes multiple faculties of abstract phenomena such as visual-spatial ability and abstract similarity (Brandefine, 2005; Celone, 2001; Horgan, 1986; Horgan & Morgan, 1988; Storey, 2000). Specific research-based practices evident in the review of literature are found within the mechanics of this qualitative case study, albeit a pragmatic extension of the literature.

Mechner (2010) describes the importance of blindfold chess as a mode to study abstract phenomena in the chess player's mind. Blindfolded chess participants consistently report that what they visualize are not physical images of chess pieces or chessboards but abstractions of these tangible objects with minimal or no physical features. Mechner (2010, p. 375) states: "A typical report is, 'I do not visualize real pieces but I know where they are.'" Research supports the practice of describing and interpreting chess lines and sequences through simulation or blindfold chess play as a model of scholarly study into the phenomenon of abstract cognition (Brandefine, 2005; Horgan & Morgan, 1988).

Chess Skill and Anticipating Outcomes

Bilalic et al. (2007) underscore the dangers of focusing on a single construct in complex real-world situations where a number of closely interconnected factors operate. Such variables can include practice, familiarity, self-selection, and experience. The research-based belief that skill acquisition is a variable demanding attention has remained relevant throughout the 20th century. Research studies indicate that observed and discovered cognitive growth relates to an increase in chess nomenclature and skill in addition to an increase in cognitive demand during

scholastic chess participation (Bilalic et al., 2007; De Bruin et al., 2007; Hong & Bart, 2007; Howard, 2012). There is an association between chess skill acquisition, practice, experience, and cognition (Bilalic et al., 2007; Hong & Bart, 2007). As students at beginning levels of chess competency improve their cognitive skills through chess participation, it is discovered that there are many mutually dependent relationships among chess and abstract cognition (Hong & Bart, 2007; Howard, 2012).

Anticipating, conceptualizing, generating solutions, and applying chess thinking to other areas of life is a theme that emerges in research on chess players. These influences appear to impact students regardless of socioeconomic status. Many disadvantaged youth can increase both academic and life success frequency by participating in local chess clubs and programs (Kennedy, 1998). The ability to conceptualize and consider real ramifications stemming from concrete events is essential to success (Kennedy, 1998). The ability to anticipate dilemmas and generate solutions in other areas of life improves with scholastic chess participation as evidenced by the systematic investigative findings (Horgan, 1986, Kennedy, 1998). Horgan (p. 9) states:

> Helping learners think logically is not easy. But our observations and research show that young children can be taught think clearly and with discipline, plan ahead, and make sound decisions. Learning these skills early in life can only benefit later intellectual development.

Scholz (2008) describes the framework of a study belonging to schools for children with learning disabilities in which teachers introduce chess during mathematics lessons. Results of this study indicate that students involved in chess play had significantly higher academic results than the students who did not receive chess-infused instruction. There is a "clear advantage of the experimental group with respect to improvement of basic mathematics skills such as counting

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and addition." (Scholz, 2008, p. 145). Scholz (p. 145) states: "... This is the first study which investigated the impact of chess lessons in classes of children with learning disabilities." This study reflects the transference of one's chess skill to other academic and life tasks or scenarios. The experimental group applies chess thinking in contextually diverse instances such as conceptualizing mathematical models and ideas. This represents successful application and abstract thought formulation where abstract cognition is evidenced by students applying knowledge to hypothetical events (Piaget, 1927).

Chess students process information, construct mental images, identify patterns, and think abstractly (Horgan & Morgan, 1988). Successful chess players of varying strengths are able to synthesize stimuli or information from the environment with mental images (Campitelli, Williams, Gobet, & Parker, 2007). Both pattern recognition and overall logic ability are evidenced by successfully completing Piagetian tasks (Horgan & Morgan, 1988). Logic ability can exhibit ambiguity within two cognitive domains, namely perception and reasoning (Linhares et al., 2012). A clear solution to successfully explaining cognition is ultimately unfeasible, as experiments of each construct demonstrate high entanglement of perception and reasoning (2012). However, an increase in perception or reasoning signifies an increase in higher-order and abstract thinking abilities (Aciego et al., 2012; Berkley, 2013; Horgan & Morgan, 1988).

The Nature of Abstract Cognition

Nippold (2009) discovered an abstract phenomenon by extracting meaning from descriptive data limited to qualitative methods while investigating chess participation. The researcher used open-ended and semistructured interview questions to engage five MHHS chess club students in general dialogue and in chess-specific dialogue both of which allowed for both the discovery and exploration of abstract thinking as a phenomenon (Nippold, 2009). The

interviews featured student explanations and vocalizations of cognitive processes within the method of 'think aloud' that produced detailed and textual data. Nippold (2009) recorded think-aloud narratives and subsequently transcribed the words into systematic analyses of language transcripts. The investigator did not implement systematic analysis of language transcripts but chose to develop and implement protocols for analysis.

Chess as a learning tool is identified by the research to increase abstract cognition among students where qualitative research produces theoretically precise results that clearly support chess as means to increase one's abstract thinking abilities (Aciego et al., 2012; Bilalic et al., 2007; Berkley, 2013; De Bruin et al., 2007; García, 2008; Hong & Bart, 2007; Horgan & Morgan, 1988). There is overwhelming evidence in support of chess as a conduit of increased abstract thinking and as a tool for learning (Aciego et al., 2012; Bilalic et al., 2007; Berkley, 2013; García, 2008; Hong, 2007). There is a relationship between chess, critical thinking, and developmental mathematics where students perceived that playing chess can improve critical thinking ability (Berkley, 2013). There are moderate to strong positive correlations between critical thinking and chess achievement in which a strong association exists between critical thinking scores and academic success (Aciego et al., 2012; Horgan, 1986; Horgan & Morgan, 1988).

Aciego et al. (2012) found that chess benefits students' intellectual and social-affective development. Specifically, 170 students between age 6 and age 16 completed IQ tests, self-report tests, and questionnaires. These measures of intellectual and socio-affective competence are traditionally used as pretests and posttests within the realm of quantitative research (Aciego et al., 2012, Horgan & Morgan, 1988). The researcher refrained from implementing standardized measures of intelligence and thinking ability as such measures are not theoretically

supported within the qualitative and conceptual framework of this study (Berkley, 2013, Bilalic et al., 2007). Varying quantitative approaches that lead to different conclusions supports an emergent theme found within the review of the literature (Bilalic et al., 2007; Berkley, 2013; De Bruin et al., 2007; García, 2008; Hong & Bart, 2007). Strictly quantitative methodology does not lead to a unifying theory of abstract cognition among scholastic chess participants, whereas qualitative and mixed-methods research offer a unifying theory of chess participation and abstract cognition (Berkley, 2013).

Empirical Data Evidencing Specific Piagetian Tasks

A significant aspect of this investigation is to add to the already, but limited, scholarly research on cognition and chess. There have been only a few studies of any kind regarding K-12 chess players, abstract cognition, and chess (Horgan, 1990; Mechner, 2010). The foundational underpinnings of modern-day chess research manifest from the understanding of how chess-enriched environments may accelerate the transition from the Piagetian concrete level of cognition to Piaget's abstract cognitive level or the formal operations level of cognition (Christiaen, 1976).

Christiaen (1976) studied grade 5 students for 2 consecutive years in which an experimental or treatment group studies chess after school, 1 day each week. After the 2-year prolonged and engaged stimulus exercise, the experimental group performed better on Piagetian tasks, performed significantly better on school tests, and performed better on standardized tests as compared to the control group (Christiaen, 1976; Horgan, 1986). Chess facilitates a faster transition from concrete thought to abstract thinking along the Piagetian continuum for which chess participation promotes intellectual maturation by significant margins of near 20% (1976). Christiaen (1976) produced foundational quantitative research while implementing a Piagetian

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framework not entirely unlike this case study exploration. This qualitative case study isn't

different from most educational and chess research, and as such can be considered an extension

of Christiaen's pioneering knowledge domain. The Prometheus of modern chess and cognition

research is described as a carefully controlled experiment or investigation involving 20 grade 5

students throughout the 1975 academic calendar (Christiaen, 1976; Dullea, 1982). Christiaen

followed students through the sixth grade as he experimented throughout the academic year.

Dullea (p. 16) states: "As might be expected of a foundation for a doctorate in psychology, the

test was carefully designed and executed, complete with a control group and other features of

good experimentation." Dullea (p. 16) continues:

> Christiaen's aim was to use chess to test Jean Piaget's theory about cognitive
>
> development, or intellectual maturation. Piaget holds that an important growth period
>
> occurs approximately between the ages of 11 and 15. In this stage, the child moves
>
> beyond physical trial and error and begins hypothesizing and deducing, developing more
>
> complex logic and judg-ment. In Piaget's terms, the youngster moves from the concrete
>
> stage to the formal stage… Piaget further contends that the environ-ment of a child can
>
> speed up or slow down the maturation. So Christiaen proposed to vary environment with
>
> either chess or no -chess. If chess were the significant variable between two groups of
>
> youngsters, any significant difference in the development of students could be attributed
>
> to enrichment brought by chess to their environment.

Much of the scholarly research at present confirms and extends earlier work regarding the

propensity of a chess program to significantly increase levels of abstract reasoning and problem-

solving in children (Celone, 2012). Both intelligence and abstract cognition in young people are

enhanced by chess instruction (Bart & Atherton, 2004; Celone, 2001; Christiaen, 1976; Martinez,

2012). Chess participation may affect the phenomenon of abstract thinking that consequentially leads to increased intelligence, increased academic success, and increased life success.

Celone (2001) aimed to substantiate and extend the growing body of evidence in support of chess as a catalyst for increased intelligence, increased abstract cognition, and increased academic performance by extending the previous work of Christiaen (1976). Celone quantitatively analyzed the effects of scholastic chess on abstract reasoning and problem-solving ability within an elementary school context. The empirical approach to measuring the phenomenon of abstract cognition as evidenced by Piagetian task ability begins with 19 self-selected chess participants enrolled in a week-long scholastic program consisting of 20 hours of chess instruction (Celone, 2001). Celone quantified existing relationships by implementing both the Test of Nonverbal Intelligence Test (3rd. ed.) and the Knight's Tour, which indirectly measures problem-solving ability. Quantitative research experiments find significant increases (i.e. $p < .01$) between the pretest scores and the posttest scores of intelligence and chess-induced cognition (Celone, 2001). Chess programs produce a significant increase in domain-specific problem-solving ability within a Piagetian framework (Celone, 2001; Christiaen, 1976).

The ability of scholastic chess to significantly increase abstract reasoning and problem-solving in students has been confirmed and generalized (Aciego et al., 2012; Bilalic et al., 2007; Brandefine, 2005; De Bruin et al., 2007; Hong & Bart, 2007; Horgan, 1986; Horgan & Morgan, 1988). Furthermore, overall cognitive ability in scholastic chess participants is strengthened by chess instruction or participation (Celone, 2001). Neuroscientific research on chess participation will prove beneficial to educators as they begin to understand the neuroscientific changes proportional to the development of chess ability and the paralleled neuroscientific changes associated with increasing scholastic achievement (Bart & Atherton, 2004). Participation in

scholastic chess increases cognitive functioning and academic achievement (Celone, 2001).

Oftentimes the empirical evidence quantifying increases in abstract cognition is enmeshed between chess and music domains (Martinez, 2012). Martinez (2012) examines the correlation of both musical instrument study and chess participation on New York state mathematics, English language arts, science, and social studies standardized test scores of suburban elementary school students in grades 3 through 5. Martinez examines the variables of chess participation, chess instruction, and practice times for the experimental groups. Martinez (p. 27) states:

> The primary hypothesis postulates that students who participate in weekly chess lessons and/or weekly instrumental music lessons will score significantly higher on standardized tests in all assessments in all grades, with students who participate in both activities scoring the highest in all groups.

Martinez (2012) finds a statistically significant difference between the standardized exam scores of a particular group of students receiving chess instruction and students not receiving chess instruction. There is a certain entanglement of treatments among subgroups and the effects of such treatments require further analysis (Martinez, 2012). There is substantial support for scholastic chess participation as a means to experience and study the phenomenon of abstract cognition although the significance level is less than moderate and concretely limited to fourth grade (Martinez, 2012). Specifically, the study's results indicate that there is a small statistically significant difference in favor of selected students who participate in chess and/or music versus those who do not (Martinez, 2012).

Visual-Spatial Ability and Abstract Conceptualization

Mechner (2010) identifies chess as a cognitive domain or topic of interest to chess enthusiasts, behavior researchers, neurobiologists, psychologists, and educators. Mechner (p. 374) states:

> The features of chess that should make it interesting to behavior analysts as a model for cognitive behavior research are these: The choices are discrete, involve purely cognitive behavior, are susceptible to registration and quantitative evaluation by computer, and the number of choices available in a given position is convenient.

Scholarly research in the chess domain pivots upon the visual-spatial demands of chess participants (Bart & Atherton, 2004; Celone, 2001; Hearst & Knott, 2009; Horgan, 1986; Horgan & Morgan, 1988; Martinez, 2012; Mechner, 2010).

Visual-spatial ability is an intrinsic component of abstract cognition (Kozhevnikov, Kosslyn, & Shephard, 2005). Kozhevnikov et al. describe visual-spatial intelligence as one's ability to mentally manipulate objects or exercise mental judgment. Students must rely on visual-spatial skills to navigate across curricula and classroom tasks throughout their academic tenure (Bart & Atherton, 2004; Horgan, 1986). Students exercise some measure of visual-spatial proficiency while completing content-specific exercises in English language arts, mathematics, and other academic areas. Students must interpret classroom stimuli such as sounds, quotes, images, theories, formulae, and ideas. Visual-spatial skills are necessary to both interpret and process the contextual information or classroom stimuli if the student is to achieve academically (Bart, 2003; Celone, 2001; Horgan, 1986; Martinez, 2012).

Successful participation in the MHHS chess club requires students to mentally manipulate chess pieces before making a best move or sequence. Facing a multitude of possible

chess moves, the player must choose the best move according to position and book theory. Not only is this an exercise in the visual-spatial realm of processing stimuli but an exercise in both visual-spatial and cognitive domains. Students who have cognitive and/or visual impairments seldom exhibit the abstract cognitive abilities necessary to performing well in secondary school and postsecondary life (Bart, 2003; Celone, 2001; Horgan, 1986; Martinez, 2012).

Piaget's theories of human development enable researchers to understand the development of spatial relations (Horgan, 1986). Children develop visual-spatial skills through manipulating objects and drawing upon abstract thinking during the discovery and the exploration of their stimuli-enriched environment. The development of spatial relations begins in the sensorimotor stage and continues through the formal operations stage (Brandefine, 2005). Bart and Atherton (2004, p. 2) describe the anatomical and physiological changes of visual-spatial processing as he states:

> From a review of research studies reporting neuroscientific investigations of chess playing, chess playing seems to involve the activation of the occipital lobe suggesting visual processing and the activation of the parietal lobe suggesting attentional control and spatial orientation.

In sequencing the events of the chess participant's brain, the occipital lobe is first activated during processing of a stimulus (Bart & Atherton, 2004). Secondly, the parietal lobes activate as mechanisms to conceptualize spatial orientation and control one's attention before the frontal lobe activates suggesting higher-order reasoning among successful chess participants (Bart & Atherton, 2004). The researcher deduces that measurable frontal lobe activity that signals advanced cognition can in turn enrich the understanding of abstract cognition among chess players.

The brain's processes that metabolize a visual perception are directly related to the biological and physiological processes of visual-spatial skill development among K-12 students (Brandefine, 2005). The literature review highlights the collective idea that intelligence is a function of many inputs as Celone (2001, p. 7) states: "Pattern recognition, calculation, abstract reasoning, concentration, intuition, deduction, visual imagery, analysis and evaluation are factors widely recognized as attributes of intelligence." Horgan and Morgan (1988) studied approximately 100 chess players of varying abilities and developmental stages and concluded that visual imagery as a product of visual-spatial skill is an essential agent in evaluating alternative chess moves, describing rational processes for choosing alternative moves, analyzing potential moves, and subsequently reassessing the board during the moment in hopes of choosing the best move out of many candidate moves. The consideration and calculation of alternative chess sequences and lines require the player to evaluate and calculate several moves in advance (Celone, 2001; Horgan & Morgan, 1988). This cognitive task fundamentally requires concentration, memory ability, and perhaps most importantly, visual imagery (Horgan, 1986). Brandefine defines visual imagery skill or visual-spatial skill as the ability to mentally manipulate objects in varying ways as evidenced in mathematics, reading, and writing.

Visual-spatial ability is directly associated with chess play as frequent chess participation positively influences linguistics and numeracy (Berkley, 2013; Scholz, 2008). Researchers Horgan and Morgan (1988) examined chess expertise among K-12 students enrolled in scholastic chess and found that chess skill is the realization of visual-spatial ability within Piaget's Formal Operations Stage. The students' spatial abilities were measured by both the Ravens Progressive Matrix and the Knight's Tour, while cognitive ability was measured by a Piagetian defined task indicative of logical ability. Chess skill improvement is directly relates to increased spatial

ability rather than cognitive ability (Horgan & Morgan, 1988). Perhaps heightened abstract cognition among chess players is intrinsically a hybrid form of visual-spatial ability rather than cognitive ability (Bart, 2003; Martinez, 2012).

The cognitive importance of visual imagery skill is not limited to abstract strategy games. Students of reading, writing, mathematics, and other academic disciplines must recognize patterns and taxonomize trends and configurations during the problem-solving processes (Horgan, 1986). The student may use chess thinking to develop a global strategy to solve the problem and complete the academic task, thus increasing academic achievement and standardized intelligence (Celone, 2001). Brandefine (2005, p. 10) states: "Playing chess can be used as a purposeful, meaningful, and fun modality by ... professionals in the school system to help children develop concepts that can improve their performance in math and English Language Arts."

Visual-spatial skills are oftentimes developed with fun, meaningful, and purposeful modalities among K-12 students. One such modality conducive to visual-spatial and abstract conceptualization gain is chess (Brandefine, 2005). Chess is an abstract strategy game that requires the participant to activate visual, spatial, visual-spatial, conceptual, and visual-conceptual perceptual processes. Improving the use of visual-spatial skills is challenging, but self-motivating to children (Brandefine, 2005). Chess play requires participants to imagine, move, and calculate a sequence or series of moves. Adult experts may recall one of several thousand book moves, whereas developing scholastic chess players must continually simplify and analyze stimuli as their schema are less developed. Although the cognitive load is sometimes strenuous, stretching such schemata to their limits and subjecting them to evaluation may speed up the process of developing more elaborate schemata (Horgan & Morgan, 1988).

Assimilation and accommodation occur cyclically as schemata evolve, thus influencing Piaget's

Formal Operations Stage of both abstract cognition and conceptualization (Horgan & Morgan,

1988).

Brandefine (2005) focused on the visual-spatial skills of K-12 students who play chess.

Storey (as cited in Brandefine, 2005, p. 9) states: "In parts of the world, chess is taught as part of

the curriculum because it is believed that it encourages the use of higher-level cognitive skills. A

positive correlation has been found between spatial and numerical abilities and the ability to play

chess well." Brandefine hypothesized that children choosing to participate in chess activity will

increase their visual-spatial relations ability as measured by the visual-spatial subtest of the Wide

Range Assessment of Visual Motor Abilities (WRAVMA). WRAVMA is a standardized test

used to analyze the relationship of scores of children that choose to play chess frequently and

less frequently with the expected performances for their ages within the norm sample reported in

the WRAVMA manual (Brandefine, 2005). Brandefine identifies a distinct relationship among

visual-spatial relations ability, abstract cognition, and chess; however, continuing research is

suggested to verify and examine this relationship.

Mechner (2010) details how chess participation is both a medium for scholarly inquiry

and a uniquely useful model for researching several issues concerning the domain of cognitive

skill and imagery. Mechner details the relationship between viewing a stimulus versus that of

mental visual-spatial imagery among blindfold chess participants' self-reporting findings. The

article describes a methodology for measuring and quantifying an individual's visual and

cognitive skill level. Mechner (p. 373) states that such methodological measures: "provide a

valid and non-arbitrary way to compare different skills and the effects of different independent

variables on a given skill, it may have a wide range of applications in cognitive skill research,

skill training, and education." An emergent theme found within the review of literature is the research-based assertion that an essential component of chess skill is the ability to mentally construct and calculate potential chess lines and sequences that requires a growing visual-spatial skill set (Horgan, 1986; Mechner, 2010).

Visual-spatial skills are compartmentally described within the visual perception processes of the brain as evidenced in the review of the literature (Brandefine, 2005, Martinez, 2012). Both hemispheres and lobes interact to interpret visual stimuli and process this input through complex interactions of visual perception processing within the cerebral organization of the brain (Brandefine, 2005). Both chess and music positively influence the progression of visual perception among K-12 students as both activities are exercises in abstract thinking (Martinez, 2012). Student increase both their visual-spatial and abstract abilities by constructing and imagining potential lines and sequences during chess play (Brandefine, 2005; Horgan, 1986; Martinez, 2012; Piaget, 1927).

Mechner (2010) details the relationship between physically viewing external stimuli and visualizing stimuli (i.e. visualization, mental imagery) by interpreting chess players' descriptions of experiences. Visualizing is internal seeing where the process of visualization is seeing stimuli in their physical or tangible absence (Mechner, 2010). Viewing an object is entirely anatomical and physiological as it involves the retina, whereas visualizing is not associated with contemporaneous external stimuli (Hearst & Knott, 2009; Mechner, 2010). Unlike visioning, viewing "permits the stimulus to be scanned and interrogated regarding even its most unimportant details" such as "color, shapes, sizes, or surface characteristics of the chess pieces" (Mechner, 2010, p. 375). Many chess masters prefer to visualize and construct abstract representations of stimuli and verbalize these abstractions with the following phrases: I don't

visualize pieces but I know where they are, I know where the chessmen are, I have some sort of formless visions of the positions, and I have an abstract type of piece representation (Hearst & Knott, 2009; Mechner, 2010). The experimenter has chosen to obtain data that evidence visualization and abstract thinking via think-aloud tasks during blindfold play.

Blindfold Chess

Chess teachers and authors hold blindfold chess as a model of skill and intellectual acumen development (Hearst & Knott, 2009; Susan Polgar Foundation, 2013). Blindfold chess is reemerging in present day chess dialogue (Susan Polgar Foundation, 2013). Several investigators have chosen blindfold chess simulations as the primary mode of discovering the cognitive processes of visual-spatial ability, perception, metallization, visualizing, and so forth (Hearst & Knott, 2009; Mechner, 2010; Susan Polgar Foundation, 2013). Scholastic chess players remember chess moves and positions by using a fundamental or guiding idea similar to remembering a well-reasoned argument (Berger, 1989). The conceptual understanding of the ideas, the reasoning, and the strategies of abstract strategy games are more important to remembering positions than recalling from memory individual moves and individual piece placement (Berger, 1989).

Berger (1989) extended perception research and cognitive organization research by investigating cognitive organization in chess. Perception in chess is described as the recognition-association model that emphasizes perceptual chunking as a basis for chess playing ability, where chunking of schemata is more important than memory recall (Berger, 1989). Cognitive and psychological research remains in a nucleus of domain-relevant tradition whereby cognitive psychologists repeatedly use the game of chess to study both problem solving and knowledge organization (Berger, 1989, Horgan & Morgan, 1988). Berger (p. 2) states: "Chess has proven to

be a rich domain because of its complexity, and yet has been amenable to analysis because of its well-defined rules and clear outcomes. Psychologists have long been interested in determining what makes a good human chess player."

The strength of a chess player is proportional to the player's cognitive and conceptual task abilities where cognitive ability is grounded in perception (Tacca, 2011). Conceptual and cognitive tasks rely on perceptual mechanisms for processing as evidenced by the supporting empirical findings (Tacca, 2011). Tacca finds that categorizing, interpreting, conceptualizing, inquiring, and reasoning are supporting actions of increased cognition and increased perception.

Berger (1989) found that abstract cognition enables chess players to successfully integrate and perceive holistically rather than compiling perceptual chunks of concrete events. Two of the three studies supported the idea that successful chess players exhibit a higher level cognitive organization. The idea of a foundational component to cognitive organization of chess lines and sequences lacks an empirical foundation; however, this study explored the many faculties of abstract cognition ability.

The combining of more foundational information into more meaningful constructs is crucial for learning and consciousness and a defining feature of the human experience (Bor, 2012). Advancing chess players begin analyzing and encoding the chess lines and sequences rapidly, which parallels the process of cognitive representation or chunking. Chunking is oftentimes complementary to attention where both processes require chess participants to compress large but finite datasets into concise quanta of meaning that are particularly salient (Bor, 2012). Chunking strictly describes the compression of conscious data as its inherent structure relates to our existing knowledge base (Bor, 2012). Chess players' cognitive progression entails chunking or cognitive sculpting of primitive input into detailed meaning, thus

requiring abstract level organization (Bor, 2012).

The phenomenon of abstract organization occurs in the minds of successful or expert chess players as they consider chess positions and the relationships among the pieces. Abstract organization is resistant to specific components found in the faculties of attention, namely memory decay and interference (Berger, 1989). Berger (p. 30) states: "... If this higher level abstract organization is not available, the expert may not be able to depend on these strong cues and may fall back on a lower level recall strategy." Tacca (2011) defines perception as the organization, identification, and interpretation of sensory information in order to represent and understand the environment. As chess players organize information into chunks, interpret a specific chess position, and identify a best move, both perception and cognition become increasingly analogous (Berger, 1989; Bor, 2012; Tacca, 2011). Both perceptual and cognitive representations among chess participants exhibit a direct association, and there is no clearly defined distinction between cognitive ability and perceptual ability. The visual perception involved in chess play depends on both sensory and cognitive factors where such cognition is inherently perceptual (Tacca, 2011).

Perception and cognition are distinguished in varying areas of the brain where information processing occurs; however, both faculties of thinking communicate during the overall culmination of abstract thought (Berger, 1989; Bor, 2012; Tacca, 2011). Both visual representations and cognitive representations share a structural property that supports the "Spatial recombination of visual representations into an object representation displays systematicity" (Tacca, 2011, p. 14). Tacca indicates that visual representations and cognitive representations exhibit the same structural properties. If perception and cognition are related, then participation in scholastic chess theoretically supports positive gains in both areas.

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Visual-spatial ability and abstract cognition may be better understood within the context of blindfold chess. Implementing blindfold chess play as a means of discovering and interpreting the phenomenon of abstract cognition is an identifiable research tactic from the supporting literature (Hearst & Knott, 2009; Mechner, 2010). Blindfold chess participants describe their experiences with adjectives such as visualize and mentalese (Hearst & Knott, 2009; Mechner, 2010). Researchers find that blindfold chess masters do not visualize images of chessmen or physical objects but cognitive abstracts of these tangible items with minimal physical attributes such as size, shape, and color (Brandefine, 2003; Mechner, 2010). Brandefine (2005) concludes that chess can affect one's visual-spatial skills; however, there is a need for further research to validate the effectiveness of chess as a catalyst of visual-spatial skill ability.

Summary

Scholastic chess participants outscore their counterparts in most academic domains (Martinez, 2012). Many alternative hypotheses stating that there is a positive correlation between chess play and cognitive abilities have been successfully established (Aciego et al., 2012; Horgan & Morgan, 1988; Linhares et al., 2012; Nippold, 2009). Clear, research-based evidence exists in support of chess as a medium conducive to cognitive and academic change where investigators continue the call for further scholarly research (Aciego et al., 2012; Horgan & Morgan, 1988; Linhares et al., 2012; Nippold, 2009). The effectiveness of chess as a model to study the phenomenon of abstract cognition has been evidenced within the review of the literature (Aciego et al., 2012; Hearst & Knott, 2009; Horgan, 1986; Horgan & Morgan, 1988; Mechner, 2010)

The emergent themes within the literature review aid in the understanding of abstract cognition as a phenomenon and the faculties of cognitive change. Chess participants

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demonstrate their ability to conceptualize hypothetical scenarios and ideas by anticipating

outcomes (Aciego et al., 2012; Horgan & Morgan, 1988; Linhares et al., 2012; Nippold, 2009).

Chess improves students' abstract cognitive abilities, coping and problem-solving capacities, and

socioaffective development (Aciego et al., 2012; Berkley, 2013; Horgan & Morgan, 1988;

Scholz, 2008). Cognitive growth relates to an increase in chess nomenclature and skill, in

addition to an increase in cognitive demand during chess play where such findings are evidenced

by Piagetian tasks (Bilalic et al., 2007; De Bruin et al., 2007; Hong & Bart, 2007; Howard,

2012). Researchers use chess to study the phenomenon of abstract cognition (Celone, 2007;

Christiaen, 1976; Horgan, 1986; Martinez, 2012).

Students exercise visual-spatial ability through the mental manipulation and abstract

conceptualization of stimuli (Brandefine, 2005). Scholastic chess participants exercise visual-

spatial ability during over-the-board chess and blindfold chess play (Brandefine, 2005; Horgan,

1986; Hearst & Knott, 2009; Mechner, 2010). Chess is an abstract strategy game conducive to

immediate feedback of problem solving ability and decision-making (Mechner, 2010). The

knowledge contained within the literature review has aided the researcher in understanding

student experiences during chess play. The review of literature identifies research practices (i.e.

blindfold chess) that were implemented in this study to better understand the phenomenon of

abstract cognition (Berger, 1989; Bor, 2012).

The complex strategy game of chess has an indeterminately high cognitive ceiling as

winning chess matches or games requires visual-spatial and abstract problem solving to control

the chessboard in hopes of winning the game (Bart & Atherton, 2004). However, there are noted

concerns of chess-specific research. There is need for continued scholarly research into the

cognitive chess domain as limitations of chess research are best summarized with one word,

namely, anecdotal (Liptrap, 1999). Both quantitative and qualitative researchers sometimes fail

to consider skill acquisition and the nature of abstract strategy games such as chess to be that of

self-selection (Liptrap, 1999). Chess may attract a relatively small, self-selected group of

students. Small samples of self-selected students are inherently predisposed to larger potential

benefits of chess instruction than larger randomly selected students (Celone, 2001).

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

The purpose of this case study is to explore the phenomenon of abstract cognition among scholastic chess participants at MHHS. Abstract cognition is defined as the formal operations stage of cognitive development (Piaget, 1927). Using this conceptual framework, four constructs were used to elicit abstract cognition data from chess participants: (1) demonstrating the ability to conceptualize hypothetical scenarios and ideas, (2) describing the process of anticipating outcomes, (3) engaging in refection about the role of chess participation, (4) anticipating dilemmas and generating solutions in other areas of their lives.

Research Questions

The central research question is how do scholastic chess players describe their experiences in the MHHS Chess Program. This study addresses the following research questions as detailed in Table 1:

Table 1

Research Questions and Data Collection Protocol Alignment

Research Question	Observation	Interview	Simulation
ï 1. How do scholastic chess players describe their experiences in the MHHS Chess Program?		✓	
ï 2. How do scholastic chess players demonstrate their ability to conceptualize hypothetical scenarios and ideas?	✓		✓
ï 3. What are the cognitive processes that scholastic chess players use to anticipate potential outcomes?	✓	✓	✓
ï 4. How do scholastic chess players describe the role of chess in their ability to anticipate dilemmas and generate solutions in other areas of life?		✓	

Qualitative Design

The design begins with a broad and central question that calls for an exploration of the central phenomenon of abstract cognition among scholastic chess participants (Farquhar, 2012). The questions address a description of the case and the emergent themes discovered from studying the phenomenon (Creswell, 2008).

Constructivism and the Case Study

The meaning of chess experience and any associated cognitive events were constructivist activities (Charmaz, 2006). This constructivist case study tradition or methodological paradigm influenced the research process and methodology, thus requiring a sustained commitment to the chosen paradigm (Lauckner, Paterson, & Krupa, 2012).

Case study research responds to a research question where data are gathered and analyzed by the researcher. Yin (2009) defines case study research as an inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. The case study tradition fostered a particular understanding or insight into abstract cognition as a contemporary phenomenon that was explored in-depth through a student's unique engagement in playing chess.

Specifically, case study research provides the opportunity to understand the phenomenon of abstract cognition that is taking place at MHHS; these findings generate insight into how the phenomenon occurs within a given situation (Creswell, 2012). The case study design allowed the questions of why and how to be answered with a relatively full understanding of the nature and complexity of the complete phenomenon (Meredith, 1998).

Role of the Researcher

The researcher functioned as the study's gatekeeper. Gatekeeping is a necessary component within qualitative studies and consequently, can affect the research endeavor in a number of ways by limiting conditions of entry, by defining the problem area of study, by limiting access to data and respondents, by restricting the scope of analysis, and by retraining prerogatives with respect to publication (Broadhead, 1976). The investigator communicated that participation in the study is entirely optional and without negative outcomes if potential subjects decline to participate. The principal researcher exercised caution as he collected data via interviews and observations of five MHHS students.

The principal investigator obtained permission to conduct research on-site and convey to gatekeepers or individuals in authority how the research provided the least disruption to the activities at the site (Creswell, 2012). The participants were not deceived about the nature of the research, and in the process of providing data (e.g., through interviews, documents, and so forth), were appraised on the general nature of the inquiry (Creswell, 2012).

Parents and guardians were informed of the nature of the interview process and how interviews can create power imbalance through a hierarchical relationship often established between the researcher and the participant. The potential power imbalance between the investigating teacher and participating student was respected as both building trust and avoiding leading questions helped to remove some of this imbalance (Creswell, 2012). Power dynamics were recognized by the social construction of knowledge in interviews to ascertain objectivity and ethicality of the interview research (Kvale, 2006).

Prior exposure to chess club and experience of playing chess are points of consideration within constructivist frameworks. The researcher's interpretation of the studied phenomenon is

in and of itself a construction (Charmaz, 2006). Prior exposure and experience are inherent in case study design and methodology; however, the impact was lessened by acknowledging the construction and co-ownership of the interpretation of the phenomena between participant and researcher. The research was made to be entirely reflective and transparent to curtail the effects of prior exposure and experience (Mills, Bonner, & Francis, 2006). Reflecting is thinking about the conditions for actions and investigating the way in which the theoretical, cultural, and sociological context of individual and intellectual involvement affects interaction with what is being research (Alvesson & Sköldberg, 2000; Lauckner et al. 2012). This research study involved the articulation of prior assumptions and experiences through reflective and analytical memos that were written prior to and during data collection and analysis (Lauckner et al., 2012).

Prior experience oftentimes manifests into working biases. Responsible research methods and statistical analyses of reliable and valid studies consider specific outcomes that may signal bias. Bias or influence does not distinguish between quantitative and qualitative research. Bias is oftentimes built-in and/or systematic and manifests from inherently flawed research design and experimenter subconscious preference (Mehra, 2002). Mehra finds researcher bias and subjectivity to be commonly understood as inevitable and important by most qualitative researchers. For this particular study, meaningful knowledge was constructed in a way that provides room for personal and subjective ways of looking at the world.

Ethics

The researcher obtained approval from the Human Research Protection Program at East Tennessee State University (ETSU) prior to researching. The researcher received IRB approval to conduct the investigation into the phenomenon of abstract thinking among MHHS Scholastic Chess Club participants and the approval letter is provided in Appendix A.

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Ethical considerations of case study research are realized in the field (Simmons, 2009). This case study adhered to an ethical procedural protocol for the conduct of case study research. First, the purpose of the study and the intended audiences was succinctly communicated to case study participants. Although the research study pivoted about the point of confidentiality, both permission and informed consent served as ethical safeguards. Furthermore, individual participant interviewees were free to allow or disallow the use of the interview containing any comments, quotations, observations, and any other information.

The study began after receiving IRB approval and after using informed consent practices. This particular investigation took place in a school setting where it is commonly assumed that consent by the school (acting in *loco parentis*) or parental consent constitutes informed consent for children to be interviewed or observed (Simons, 2009). Educational research involves large sample sizes, but case research is vastly more intimate and lesser scaled (Patton, 2009; Simons, 2009). The researcher adhered to the same ethical precepts exemplified in adult research. This study followed specific guidelines, namely, do no harm, respect participants, do not lie, treat people fairly, gain informed consent, and allow the right to withdraw (Simons, 2009).

The researcher developed and succinctly articulated informed consent documents (see Appendix B), child assent documents (see Appendix D), and parental permission forms (see Appendix C). Each of the three documents clearly detailed the exact purpose of the research, the qualitative research methods employed, and the data collection protocols. The documents were distributed to each participant or both the participant and parent if the student was a minor during the time of investigation. As per IRB requirements, the consent and assent documents emphasized the participants' rights to refuse participation, to withdraw from participation, or to modify their participation without impunity.

Setting

Case study methodology supports the general aim of qualitative research as it aids in the development of concepts necessary to understand abstract cognition phenomena in natural settings (Creswell, 2012). The case method allows the questions of why and how to be answered with a relatively full understanding of the nature and complexity of the complete phenomenon of abstract cognition (Creswell, 2012). The phenomenon of abstract cognition was studied in its natural setting where the study's practice may inform future studies that generate theory (Farquhar, 2012). This study defined a natural setting to be a setting in which there is no staging of dialogue, minimal interviewer interference, and freedom to engage in semistructured interviews with open ended dialogue. The physical setting was 333 Mountain Heritage Drive, North Carolina. The recorded interviews occurred during designated times at the convenience of the interviewee during the month of August, 2014.

Population

This study's identified population is that of 30 scholastic chess club participants at MHHS. The researcher does not attempt to generalize findings to all people or all groups but rather seeks information that elucidates programmatic variations and significant common patterns of abstract cognition among five MHHS chess club members (Patton, 1990).

Sampling Strategy

Sampling criterion is useful for both identifying and understanding cases that are information rich. This study used nonrandom purposeful maximum variation purposive sampling to the point of data saturation. The concept of theoretical saturation limited the sample to five participants. In qualitative research sample selection has a profound effect on the ultimate quality of the research. Both the importance and reasons of purposeful sampling generates from

the selection of information-rich cases for in-depth study. Information-rich cases are those from which one can learn a great deal about issues of central importance to the purpose of the research, thus the term purposeful sampling (Coyne, 1997). The researcher employed a maximum variation sampling strategy using the criteria of student background characteristics (Patton, 1990). The sampling criterion enabled the researcher to identify a scholastic chess sampler that supported the merit of this case study.

Gerring (2007) finds that case-selection procedures rest upon an analysis of a larger population of potential cases. The cases identified for intensive study are representative of a specific population. A focused case study that provides insight into the phenomenon of abstract cognition must implement cases representative of a broader set of cases (Gerring, 2007). The researcher implemented a nonprobability or nonrandom sample that objectively produced a sample that was representative of the MHHS scholastic chess club student body. This required a well-informed knowledge base of the population.

Purposive maximum variation sampling enabled the inclusion of individuals who were determined to have had different experiences, while investigating core elements and shared outcomes (Patton, 1990). By studying a sample rich in individual variation, the study and the study's findings were designed to gain academic merit and credibility.

Sample

Maximum variation sampling supports examples of race, class, gender, and individual variations; however, this study exercised the theoretical freedom to elect samples that represent phenomenal variation. Coyne (1997) details phenomenal variation as variation of the target phenomenon under study. Rigor was established by prioritizing phenomenal variation to cover important variables associated with the phenomenon of abstract cognition (Coyne, 1997).

When combined, the sample demographics represent the typical secondary scholastic chess pupil. Through purposive sampling techniques, participants were identified and chosen according to their backgrounds, academic experiences, academic achievement levels, and individual characteristics. The sampled students were those with the richest, thickest exposure to the phenomenon of abstract cognition through chess participation, using maximum variation criteria of background characteristics (Creswell, 2012; Patton, 1990). Therefore, the study sampled a low-achieving student, a high-achieving or gifted student, an economically advantaged student, an economically disadvantaged student, and an At-Risk student.

Data Collection Procedures

As common with qualitative analyses, there are various forms of interview design that can be developed to obtain thick, rich data using a qualitative investigational perspective (Creswell, 2007). The first step of data collection in this study was to conduct pilot interviews to test the research questions and to adjust interviewing skills if necessary (Weiss, 1994). Piloting interview questions aided in identifying any flaws in the interview protocol and questioning techniques designed by the researcher. Further, a pilot interview enabled the researcher to identify any ambiguities in the information given to and received from the participants (McLeod, 2007). Essentially, the purpose of any pilot or feasibility study is to assess the feasibility of an investigation or to improve the design of an experiment (McLeod, 2007). The pilot study was conducted on May 09, 2014, at MHHS. There were no modifications made from the pilot interview as the pilot did not reveal any apparent deficiencies in the main study's design; however, the pilot is considered generally small and there are not enough data to warrant revision to the investigative design. While many pilots are performed with relevant population members, the researcher did not pilot with future participants as such would potentially influence the

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research subjects' behaviors during the main study. It was unnecessary to perform a second pilot study to assess the revised study or focal study.

Interviews

The second step in data collection was the use of the piloted semistructured interview protocol to explore the phenomenon of abstract cognition among scholastic chess club participants (Thomas, Nelson, & Silverman, 2011). The researcher must exercise skill and tact in establishing rapport with the interviewees in anticipation that the participants will open up and describe their true feelings, thoughts, and intentions (Thomas et al., 2011). Thomas et al. find that complete rapport is established with time as the researcher and participant become to know and trust one another. Skillful interviewing is characterized by appropriate verbal and nonverbal cueing, flexibility in reframing and pursuing certain lines of questioning, and by digital, written, and physical documents (Thomas et al., 2011). The interview, observation, and simulation protocols were designed using the Piagetian Formal operations stage framework (Piaget, 1927). This conceptual framework enabled the researcher to investigate the meaning of abstract cognition as a phenomenon and discover and explore this phenomenon through thick and rich description.

The interview protocol is structured with a set of questions that the interviewer asked every participant and, when necessary, probing or follow-up questions varied by participant. The interviewer questioned each student to delve further into the experience of playing chess and how that experience translates into other aspects of life. The interview protocol is provided as Tables 2, 6, 7, and 8.

The third step of data collection was the development and implementation of a chess simulation activity whereby the interviewer became participant-observer. The researcher

actively participated in chess simulations and/or applied stimuli to solicit participant responses

associated with the cognitive processes while responding to the simulations and interaction with

the interviewer. Representations of the simulation activities are provided in Tables 3, 4, 5, 6, and

7.

The fourth and final step in data collection was an observation protocol (Tables 3, 4, 5, 6,

and 7). The protocol was an open-ended observational log to help capture observable behaviors

of chess players and included actions, mannerisms, nonverbal and verbal incidents that enabled

the researcher to develop analytic memos in the development of codes, categories, and emergent

themes. The observation protocol was designed to be flexible and open as points of interest

emerged. Chess participants were observed as they engaged in blindfolded chess play with an

opponent. The researcher then documented and recorded behaviors (i.e. body language,

frustration points, elements that lead to futuristic thinking). The idea was that through observing

and questioning the students during chess-specific activities, additional descriptive, rich data

would offer clues to understanding the players' cognitive processes. The following tables

illustrate the relationship among the interview questions, the research questions and the

associated data collection protocols:

Table 2

Research Question 1 and Protocol Alignment

Interview Question	Data Collection Protocol
ï 19. How would you describe the average club member's MHHS Chess Club experience?	Interview
ï 20. How have you changed since participating in chess club?	Interview
ï 21. How do you explore the world since participating in chess club?	Interview

Figure 1

Research Question 2 and Protocol Alignment
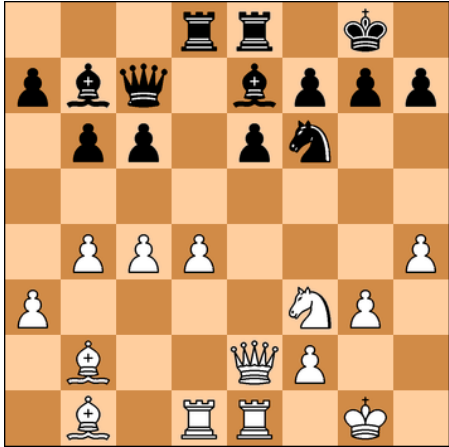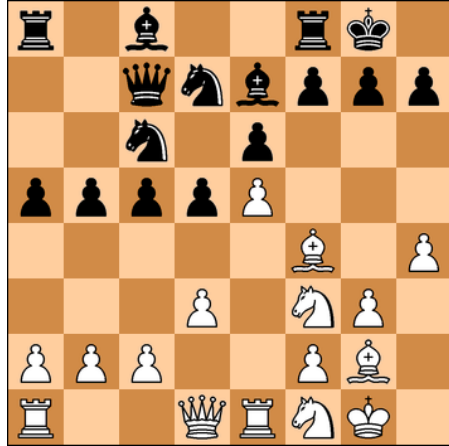
Interview Question	Data Collection
Ï 8. The interview participant will engage in blindfold chess by responding to 1. e4 (standard opening), and then engage in chess play by verbalizing their lines and/or positions.	Observation, Simulation
Ï 9. The interviewee or study participant will engage in blindfold chess by responding to 1. Kf3 (flank opening), and then engage in chess play by verbalizing their lines and/or positions.	Observation, Simulation
Ï 10. The interviewee/participant will engage in blindfold chess by opening with a move of their choice, and then engage in chess play by verbalizing their lines and/or positions.	Observation, Simulation
Ï 11. Develop past potential lines or sequences leading to the following chess position: (Black to Move)	Observation, Simulation
Ï 12. Construct possible sequences leading to the following position: (Black to Move)	Observation, Simulation

Figure 2

Research Question 2 and Protocol Alignment
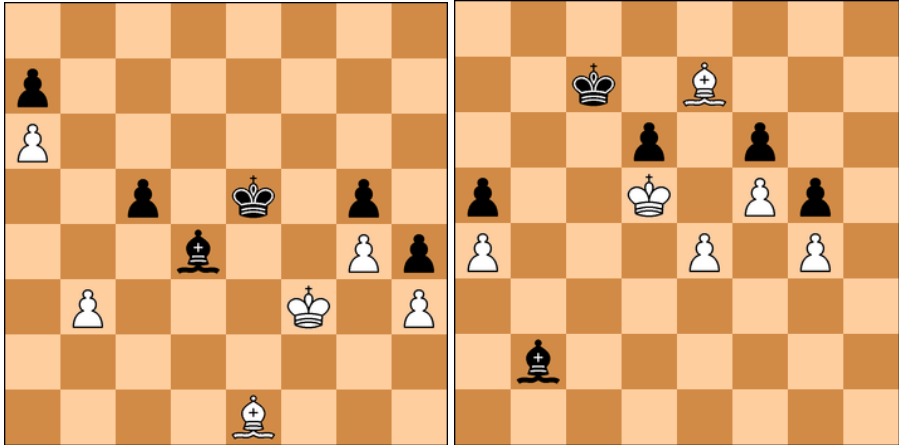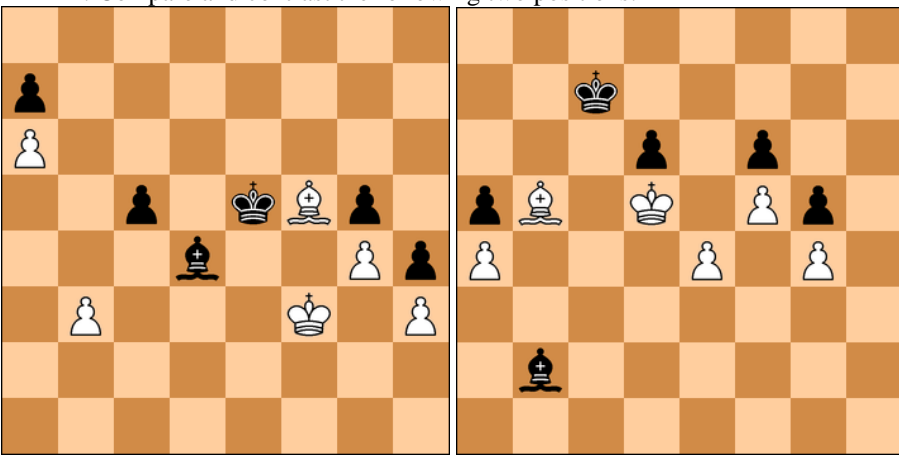
Interview Question	Data Collection
ï 13. Compare and contrast the following two positions: 	Observation, Simulation
ï 14: Compare and contrast the following two positions: 	Observation, Simulation

Figure 3

Research Question 2 and Protocol Alignment
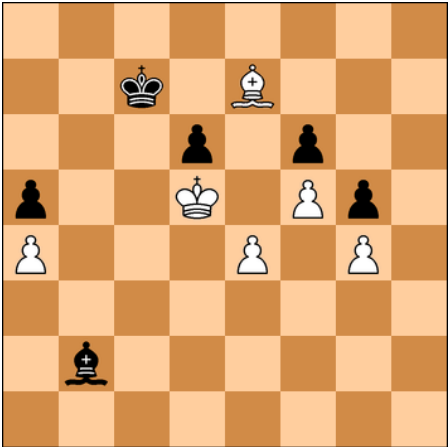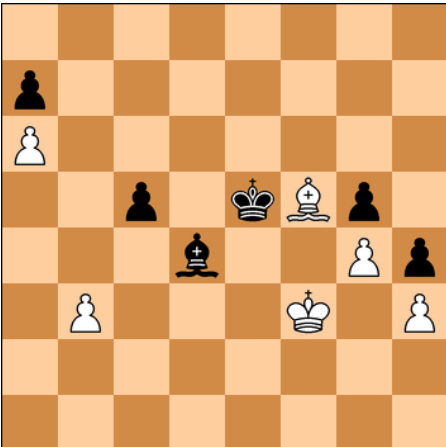
Interview Question	Data Collection
Ï 15. Identify two similar pairs from the following four positions:	Observation, Simulation

Figure 4

Research Question 3 and Protocol Alignment

Interview Question	Data Collection Protocol
The following position is a variation of Legal's Mate. Legal's mate is a potential mating sequence that is encountered by many chess players, albeit in differing variations: 1. e4 e5 2. Nf3 c6 3. Bc4 d6 4. Nc3 Bg4 5. h3 Bh5. **Cheron vs. Jeanloz: Leysin, 1929** (White to move)	
1. How can White take advantage of Black's positional play? Verbalize your thinking throughout the sequence.	O,I,S
2. Are you able to identify White's potential mating sequence? If so, demonstrate this line over the board and describe in detail your thought processes.	O,I,S
3. What are your thought processes that you use to anticipate potential outcomes (i.e. exchange sacrifice, simplification, calculation)? Simulate any anticipated outcome over-the-board.	O,I,S

Figure 5

Research Question 3 and Protocol Alignment
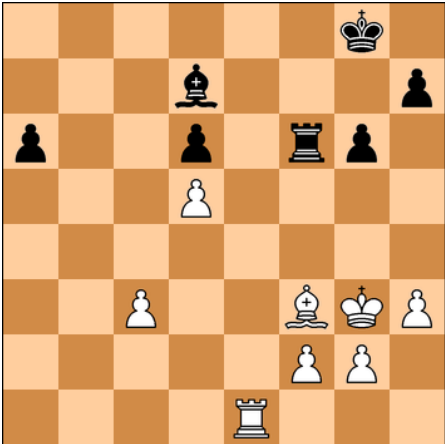
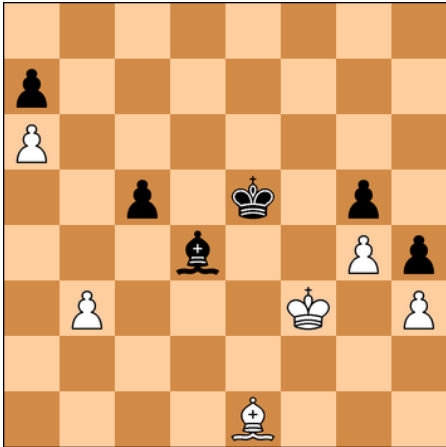| Interview Question	Data Collection Protocol
For interview questions 4-7, consider the following position that arises after: 1. d4 Nf6 2. c4 c5 3. d5 g6 4. Nc3 Bg7 5. e4 O-O 6. Bd3 e6 7. Nf3 exd5 8. cxd5 d6 9. h3 a6 10. a4 Nh5 11. O-O Nd7 12. Re1 Rb8 13. Be3 Ne5 14. Be2 Nxf3 15. Bxf3 Nf6 16. Bf4 Ne8 17. a5 b518. axb6 Rxb6 19. Na4 Rb4 20. Bd2 Rb8 21. Bc3 f6 22. Qd2Nc7 23. Ba5 Qe7 24. Nxc5 Nb5 25. Na4 Qa7 26. Bb4 f527. Nc3 fxe4 28. Nxb5 Rxb5 29. Rxe4 Qb6 30. Bc3 Bxc3 31. bxc3 Qd8 32. Rae1 Rb7 33. Rf4 Rbf7 34. Rxf7 Rxf7 35. Kh2 Bd7 36. Qd4 Qf6 37. Qxf6 Rxf6 38. Kg3 **Atalik vs. Khomyakov: Alushta, 1999** (Black to Move)	
4. Conceptualize and accurately describe what it might have been like to be Khomyakov and down a pawn (i.e. Black's thought processes). Simulate any potential sequences over-the-board	O,I,S
5. Although Black's position is relatively solid, Black has a passed pawn on a6 that can be protected by Black's bishop and White's bishop is blocked by the d5 pawn. Black's position is said to be critical (Naroditsky, 2012). Consider White's perspective by describing White's thinking and what he intends to do. What might White be thinking? Describe White's thought processes. Simulate any potential sequences over-the-board	O,I,S
6. According to Naroditsky (2012), Black's ...a5 response simply loses for Black. Why is it necessary for Black to activate his rook? Describe your thinking while simulating any relevant sequence over-the-board	O,I,S
7. The game continues with 38. ...a5 39. Ra1 a440. Bg4 Be8 41. Be6 Kg7 42. f4 Bb5 43. c4 Be8 44. Rb1 Rf845. Rb7 Kf6 46. Ra7 h6 47. Kf3 g5 48. f5 Ke5 49. Ke3 h5 50. g3 Black Resigns. Annotate (on paper) moves 38 - 50 and detail, "What does my opponent aim to do?"	O,I,S

Table 3

Research Question 4 and Protocol Alignment

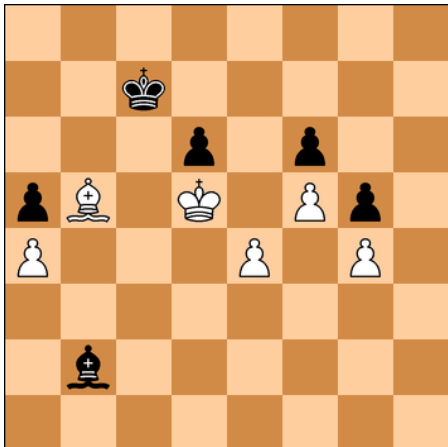| Interview Question	Data Collection Protocol
ï 16. How would you describe the role of chess in your ability to anticipate future events, to mentally visualize life problems, and find solutions? Explain.	Interview
ï 17. Has chess enhanced your thinking and learning? Explain.	Interview
ï 18. Have you used same thinking processes required during chess participation to address a decision? If so, when? Describe the event.	Interview

Owen (2013) details how documents can be direct written manifestations of transcribed and converted interviews and observations. Documents support description as the foundation of qualitative inquiry where both written and recorded documentation are rich in descriptive language. Documents further facilitate the researcher's task to extract meaning from the data (Owen, 2013). Documents may serve as the outputs or by-products of the study's data collection methodology. The documents are not limited to any one form (i.e. written form and audio). Although documents can provide crucial information prior to designing and conducting research, this study did not use document analysis to corroborate or refute any observational, interview, and/or simulation findings. Rather, the investigator implemented an audit trail of documentation.

Descriptive coding was used as a preliminary data analysis tool.   This viable approach to data analysis provided a summary in concise language of the essential theme of an interview and other elements (Owen, 2013). Further, descriptive coding easily supports taxonomy via an inventory, tabular account, summary, or index of the data's content (Owen, 2013). The data sources of observation, interview, and simulation combined with field notes, personal memos, and textual thoughts resulted in data saturation for analysis.

The researcher allocated an appropriate amount of time such to collect meaningful data

that resulted in a vivid understanding of the phenomenon of abstract cognition among chess participants. Artifact analysis of the simulation activities followed data collection and included written narratives describing the data collection process, field notes, audio products, and photographs. Each artifact was documented as detailed above and from the analysis of the documents, the artifacts were explored.

Participant engagement activities are aligned with the research questions (See Table 1 *Research Questions and Data Collection Protocol Alignment*). The participant-interviewee activities were documented in their entirety during the qualitative investigation. The simulation protocol was structured as it is applied in the design and implementation of the chess position activities detailed in Figures 1, 2, 3, 4, and 5.

Data Management

Participant names for this qualitative case study were masked or coded with pseudonyms. The pseudonyms were held and locked in a file entirely separate from the original data sources. All transcripts, observations, and simulation data were masked with pseudonyms.

Measures of Rigor

The researcher used four criteria for evaluating qualitative and interpretive investigative work (Lincoln & Guba, 1985; Zhang, 2005). These four criteria for evaluating constructivist work are credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985; Zhang, 2005). The following strategies were employed to achieve credible, transferable, dependable, and confirmable work: Triangulation, member checks, thick description, purposive sampling, audit trail, code-recode strategy, expert scholarly peer review, and reflexivity.

Credibility

Creswell (2003, p. 195) states: "[validity] is used to suggest determining whether the findings are accurate from the standpoint of the researcher, participant, or the readers of an account." The researcher considered eight verification and internal validity strategies that are implemented in qualitative studies and chose no fewer than two (Creswell, 2003). The researcher implemented these two verification strategies, namely, triangulation and member checks.

Triangulation. Creswell (2008) identified powerful data collection protocols and methodologies including document analysis, interviewing, observing, and simulating. Protocols of interviewing, observing, simulating, and document analyzing theoretically support triangulation that increases the validity of any study. Triangulation and member checking work well for case study research (Anfara, 2002). The researcher triangulated the varying data sources and the data collection procedures to identify a unifying theory or convergence of thematic units.

This study's qualitative analysis of interview text was supplemented with other sources of information (i.e. field notes, simulation notes, observations) to satisfy the principle of triangulation and increase trust in the validity of the conclusions. Analysis of transcribed interviews, observational field notes, and documents have remained a constant, iterative process throughout the data collection and analysis phase. The researcher categorized and structured documented ideas into categories, defined their properties, and made sense of any relationship discovery between categories (Suter, 2012). This strengthened internal validity and allowed the data to reach the point of saturation. Saturation generally signals the completion of a study when there is a judgment of diminishing returns and little need for more sampling (Suter, 2012). Suter (2012, p. 350) identifies saturation as "the point in continuous data collection that signals little

need to continue because additional data will serve only to confirm an emerging understanding."

 Member Checks. Researchers can use a combination of data collection protocols such as observations, interviews, and document analyses to both validate and cross-check initial findings (Merriam, 1998). Internal validity can be enhanced by triangulation, peer review, member checks, and explaining researcher bias (Merriam, 1998). Member checks were confirmed by the interviewed chess participants. Participants received a hardcopy of their interview transcription and were asked to assess their interviews for credibility and accuracy. All discrepancies between interviewer and interviewee were addressed and remedied. For example, Junior further explained what was meant when Junior referred to being defeated in chess and provided additional insight and clarity into the understanding of the verbal transcription.

Transferability

 Transferability is a qualitative term to describe external validity (Creswell, 2012; Suter, 2012). The strategies employed by this study that strengthened transferability are thick description, purposive sampling, and cross-case comparisons. Transferability is evidence supporting the generalization of findings to other contexts in which detailed descriptions enable judgments about transferability with other contexts (Suter, 2012).

 Thick Description. Thick descriptions of the students' perceptions were provided for comparison. Upon comparing the thick descriptions of the documents, comparisons were then considered in areas of life, school, and abstract gaming.

 Purposive Sampling Strategy. Patton (2002) finds that purposive sampling is sampling that does not emphasize generalizing between sample and population but rather focuses on the potential of the sample to generate insightful data from its illuminative information sources. The investigator purposively sampled a case of five MHHS scholastic chess club participants.

Dependability

Zhang (2005) describes qualitative research dependability as an internal coherent process of accounting for changing condition in the phenomena. The major technique for establishing dependability is the use of a transparent coding process of verification where the inherent ambiguity of word meaning and category definitions are best handled with consistent coding schema (Zhang, 2005).

Audit Trail. This particular study constructed an audit trail or a transparent description of the entire research process from beginning to end. Research study documents and records were fastidiously filed and stored. Specific items made available for the audit trail include field notes, raw data, personal notes, pilot exercises, feasibility plan, and instrument development rationale.

Code-Recode Strategy. The initial or primary cycle codes were efficiently subsumed by other codes, relabeled, or dropped altogether (Saldana, 2008). Saldana finds that exercising both patience and flexibility enables the researcher to progress toward second and third cycle coding. The researcher rearranged and reclassified coded data into new and differing categories for the data analysis portion of this story (Saldana, 2008). The code-recode strategy remained open-ended throughout the investigation but, as expected, became more and more specific and concise throughout the research process.

Triangulation. Triangulation is an internal validity procedure where researchers look for convergence among and between multiple and different sources of information when forming themes or categories in a study (Creswell & Miller, 2000). Case research studies assert triangulation by using multiple investigators, multiple sources of data, and/or multiple methodologies to confirm emerging findings (Merriam, 1998). Triangulation increased internal validity by combining data sources to study the phenomenon of abstract cognition. This

approach led to one specific mode of triangulation, namely, data triangulation (Hussein, 2009). A within-method triangulation process required cross-case checking to confirm or disconfirm internal validity and consistency (Hussein, 2009; Strauss, 1967). The researcher used the constant-comparative method in the analysis of the data to increase internal validity (Strauss, 1967).

Expert Scholarly Peer Review. Expert scholarly peer review of the data was a method used to establish content validity and confirmability. The interpretations of data between researcher and the external review team, the dissertation chair and committee, were compared and contrasted with attention to both similitudes and differences in interpretation.

Confirmability

Triangulation. Creswell and Miller (2000) propose a conformability strategy namely, disconfirming evidence, where categories and emerging themes in the within-method analysis are compared across different cases.

Reflexivity. Reflexivity is a method of credibility that this investigation used throughout the case study. Bracketing biases and journaling assumptions about perceived interpretations increased bias awareness. Physical evidence of bracketing and journaling was used when transcribing and adding contextual data to observational notes and field notes.

Data Analysis

Qualitative coding is concerned with data retention where the goal is to learn from the data and to revisit the data until patterns and explanations begin to emerge (Creswell, 2012; Patton, 2012; Richards, 2005). This requires thorough data records or the relevant parts of them until an understanding of the data is achieved. Extracting meaning and formulating an understanding of the data parallels "... Making sense out of what people have said, looking for

patterns, putting together what is said in one place with what is said in another place, and integrating what different people have said" (Patton, 2002, p. 380). Such an understanding of the patterns and explanations must be evidenced as artifacts (Richards, 2005). The researcher developed a coding protocol that evolved throughout the research process. The realized protocol is one of constant and continual comparison. This study's protocol produces "tentative categories that are then compared to each other and to other instances" throughout the constant comparative method of data analysis (Merriam, 1998, p. 159). The researcher used the constant comparison method to extract conceptual categories, themes, and units. Coding allowed for the identification of shared themes among the following data collection protocols: Observation, Interview, and Simulation. After identifying the emergent themes, the researcher continued the iterative process by grouping commonalities and recurrent thematic units. Code mapping involved three iterations of analysis and is detailed by the principal investigator in Table 4.

Table 4

Code Mapping: Three Iterations of Analysis (to be read from the bottom up)
CODE MAPPING FOR ABSTRACT COGNITION
(Research Questions 1, 2, 3 and 4)

RQ1: How do scholastic chess players describe their experiences in the MHHS Chess Program?	RQ2: How do scholastic chess players demonstrate their ability to conceptualize hypothetical scenarios and ideas?	RQ3: What are the cognitive processes that scholastic chess players use to anticipate potential outcomes?	RQ4: How do scholastic chess players describe the role of chess in their ability to anticipate dilemmas and generate solutions in other areas of life?

(THIRD ITERATION: APPLICATION TO DATA SET)

Abstract Cognition:
Scholastic Chess Club Participation

(SECOND ITERATION: PATTERN VARIABLES)

1A. Culture of Self-Regulated Learning 1B. Socialize in a Competitive Environment	2A. From Concrete to Abstract 2B. Blindfold Chess and Abstract Similarity	3A. Anticipating Potential Outcomes 3B. Anticipation vs. Pattern Recognition	4A. Visualizing Action and Reactions 4B. Possible Solutions

(FIRST ITERATION: INITIAL CODES/SURFACE CONTENT ANALYSIS)

1A. Challenging 1A. Confidence and Winning 1B. Independent Study and Continuous Improvement 1B. Fun and Engaging	2A. Visioning vs. Visual 2A. Seeing 2B. Too Hard to Imagine 2B. Similar, but Not the Same	3A. Consider All Hypothetical Sequences and Lines 3A. Minimal Detail 3B. Tactics and Book Lines 3B. Cognitive Paradigm Shift	4A. Visioning vs. Visualizing 4A. Identifying the Best Possible Move 4B. Sequencing 4B. Analysis of Lines

Data Presentation

Data analysis led to the development of a master code table that indicates how codes fit into categories. Identifying and developing thematic units from the data analysis required first-round and second-round coding. The researcher achieved first-round coding by using line-by-line coding of the interview transcriptions, incident-to-incident coding of the observation protocol, and axial coding of the simulation data. Then the researcher performed second-round coding of all data using the constant-comparative method before developing a master code list. Specific findings for each of the four research questions are presented in written form within the body of this text. Both the data and summary of the research findings associated with the qualitative analyses of the interviews, observations, and simulations are presented in Chapter 4.

CHAPTER 4

DATA ANALYSIS

Introduction

The purpose of this research study was to examine the phenomenon of abstract cognition among five scholastic chess participants as they participate in over-the-board chess play, blindfold chess play, and chess simulations. One central research question with three supporting questions informed this qualitative case study.

In responding to semistructured interview questions and observation protocols, study participants described their cognitive processes. Students detailed how their thinking informed decisions, how they anticipated dilemmas, and how they visualized hypothetical scenarios. This abstract experience illuminated the nature of abstract thinking. Students discussed their abstract cognition within the context of scholarly and life decisions. Both the analyses and research findings of semistructured interviews, researcher's field observations, simulations, visual and blindfold chess play are presented in Chapter 4.

Much of the study's credibility comes from the triangulation of interview responses, researcher memos, observations, and member checks. Qualitative data from the methods of collection were coded according to concepts, the categories, and thematic units. There exists an identifiable and uniform consistency of abstract phenomenon among the three data collection methods (Bilalic et al., 2007; Horgan, 1986; Linhares et al., 2007). Data analysis began with the triangulation of interview responses before implementing member checking. The constant comparison method was implemented in an iterative or idiographic fashion. Interview question responses, observational field notes, and simulation results were continuously reviewed throughout the study's iterative coding process.

The five semistructured interviews occurring during the month of September 2014 produced the data used in interpreting and analyzing the phenomenon of abstract cognition among the purposive sample. All participants received a copy of their interview transcriptions in written form and were encouraged to systematically review the verbal accounts, thus increasing this study's credibility. This process of member checking was easy to implement and was found to be efficient and effective. The process of member checking encouraged the participants to review their responses and the researcher's interpretations and transcriptions of their words. The five student participants received gender-specific aliases and are identified as Edward, James, Junior, Carly, and Jerelene.

Participant Profiles

This study's five participants were enrolled in the MHHS chess club during the 2013 and 2014 calendar years, in which this study evolved. Both the participants and the participants' individual demographic are described in the body of this text. Edward, James, Junior, Carly, and Jerelene collectively represent the low-achieving student, the high-achieving or gifted student, both the economically advantaged and disadvantaged student, and the At-Risk (academic failure) student. Each participant student is succinctly described in the proceeding descriptions. The sample representativeness of the diverse study body population will direct any subsequent research efforts concerning cognitive functioning among scholastic chess participants, although the researcher sought to better understand a phenomenon among a distinct MHHS population.

Edward receives free and reduced lunch and has an individual education plan (IEP) on file at the school. The local education agency (LEA) has declared Edward At-Risk for academic failure by virtue of his life circumstances; however, he continues to remain in school while he actively seeks to lessen reports of off-task behavior(s). Edward's academic progression is

gaining momentum, which is evidenced by the increase of his weighted grade-point-average. Edward is a chess club regular and enjoys the social atmosphere of the club. Edward was interviewed on three separate occasions at MHHS during the month of September, 2014.

James is a low-achieving student; however, he excels in areas aligned with his creative interests. James began participating in scholastic chess as a freshman and continued his tenure until transferring to the North Carolina School of the Arts, Raleigh, North Carolina. James's preferred artistic medium is acrylic paint; however, he enjoys studying music theory and performing live at various venues. He considers chess art but enjoys the analytical and formal logic requirements of competitive chess play. James was interviewed throughout the month of September 2014 in alternative formats as a response to his geographical proximity from the University of North Carolina Visual Arts School.

Junior is ranked second among his peers in the MHHS scholastic chess club. Junior's family members are both economically advantaged and interested in Junior's chess experience. Junior's academic achievement is considered average in each of his core classes; however, his scholarly progress has improved since enrolling in the MHHS Scholastic Chess Club. Junior is incredibly competitive and the abstract strategy game of chess meets such a demand. Junior completed the interview process in one 5-hour setting.

Carly is an adult graduating senior at MHHS. She is among the best chess players in the club and now among the top 30% of her graduating class. Carly comes from an economically disadvantaged single parent home in which her mother relies heavily upon Carly for domestic aid. Carly was interviewed during the afternoon hours as she returned from a dual-enrollment course at a partnering 2-year college serving similar demographics as that of Carly's demographic.

Jerelene is an academically gifted sophomore who is both involved and interested in all of her course subject material. Further, Jerelene is en route to become valedictorian of the 2017 class. During the summer months Jerelene enrolls in college courses and programs throughout the states. Jerelene attends all club meetings and is overcoming her fear of failure by competing with a myriad of chess players with unique talents and abilities. The entirety of Jerelene's interview was less than 2 hours.

Researcher's Notes and Memos

The researcher began journaling field notes, personal memos, and textual thoughts during the semistructured interviews commencing in September 2014. Here the researcher's thoughts and comments were conceptually coded into distinct and emergent categories. Such notes detail the researcher's conceptual mapping of students' scholastic chess participatory experiences and perceptions at MHHS. Mapping was essential to the investigation of abstract phenomena. The researcher found that the five MHHS scholastic chess participants thoroughly enjoy their chess club experience from the review of journal activity. Participating pupils enjoyed navigating through the interview process as each particular chess topic, activity, line, and sequence presented an exciting intellectual challenge not unlike their club experiences.

The researcher's memos note that chess pupils enjoyed solving chess complexities with abstract thinking, chess theory, and tactics. Edward's interview response supported the researcher's understanding of the cognitive processes that MHHS chess participants use to anticipate potential outcomes:

The participant seems eager to describe their thinking and is entirely engaged in the task so much, that they have forgotten about sharing the room with me… He [Edward] is like the others as he seemingly presents his thinking in the context of a spirited debate in

which he rationalizes hypothetical moves with and without the chess board. Other participants exhibit a similar intensity and elation when they believe to have found an absolute winning strategy or idea.

It is with excitement of play that participants describe the cognitive processes used to anticipate potential outcomes (Research Question No. 3). While responding to interview questions 1 through 7, the students seemed particularly excited when asked to find and identify best moves, to take advantage of poor positional play, and to identify a potential mating sequence. In response to RQ3, Junior stated:

Chess is war, chess is a battle. If you don't take time to think about what could happen and consider all the um, possibilities, then you will be defeated. I don't want to lose a match since I have so much fun playing. So, I have to think hard and make sure that I calculate well, um… That I think about what the enemy wants to do."

Junior's perspective reflects that of both male and female participants and perhaps most importantly, it is the way in which Junior and his peers respond to the interview questions that is particularly interesting. When describing both their thinking and their opponents' thinking, the interviewees become increasingly focused, concentrated, and energetic. The researcher examined journal entries then subsequently realized that such displays of energy are associated with a genuine interest in the chess culture, the fun of learning, playing, and competing one with the other.

During the interview process the researcher scribbled: "The student participants use similar words, phrases and slogans when responding to interview stimuli. There is evidence of a burgeoning chess culture complete with its own idiosyncrasies and dynamics here at MHHS." The researcher continued: "The responses, vocalizes and actions of the participants suggest a

certain conformity to advanced thinking strategies and an intellectual collegiality." From analyzing the notes, it became apparent that students had inadvertently described their chess experience with physical and verbal cues in response to the study's interview, observation, and simulation protocols. Upon tabulating the usage of descriptive, vivid, and specific language, the researcher finds a disproportionately high frequency of the words challenging, winning, competitive, engaging, improvement, consequential, demanding, exciting, engaging, awesome, and fun. Further analysis of researcher notes and memos enabled the principal investigator to conclude that MHHS chess players are members of a learning culture that happily describe their abstract cognitive processes and find intellectual pleasure in anticipating potential outcomes. If anticipating hypothetical scenarios and events is considered fun and engaging by the whole of the study participants, then one must describe the scholastic chess experience as partly so.

One gains insight into how chess players demonstrate their ability to conceptualize hypothetical scenarios and ideas from analyzing the researcher's journal entries. Qualitative interview questions 8 through 15 produced descriptive data that allowed the researcher to discover and understand how scholastic chess players demonstrate their ability to conceptualize hypothetical scenarios and ideas while simultaneously describing their collective club experiences. The researcher found that participants consider blindfold chess to be a positive practice, a practice in which students enjoy the challenge of mental play and the associated cognitive benefits (i.e. increased visualization, increased spatial acumen). While James was somewhat apprehensive when considering blindfold chess play, Edward, Carly, Jerelene, and Junior shared similar sentiments immediately preceding and following the observational simulation experience. The five study participants expressed that blindfold play while challenging is indeed fun and beneficial to their thinking processes. All but one participant had

participated in blindfold chess play before the interview process.

During cognitive assembly and vocal description of spatial-visual and abstract formulations among the interviewees, the researcher noted the following:

As the student develops potential or hypothetical chess lines and sequences that lead to concrete positions, the participant exhibits tenets of self-motivation and self-regulation as evidenced by their language and behavior. The pupil is walking around the room processing the domain specific information on the board and seemingly prefers to reason through the task of comparison and contrasting mentally with imagery and visualization, rather than viewing and/or physically moving chessmen… The behavior and vocalized responses of the participant indicate that abstract cognition is not mere analytical and computational proficiency, but holistically artistic in practice. When asked to identify similar pairs from four positions, the student again uses language indicative of a social learning culture within the school. The student has grown increasingly pleased with herself as she completes each assigned task.

The researcher finds that blindfold chess is considered by the participants as a positive tool for cultivating and increasing cognitive ability or more specifically abstract cognition. Each student wielded comment phrases such as mental battle, anticipate opponent's moves, think about hypothetical situations, and so forth. Some comments indicate that the anticipatory tasks such as those detailed in questions 12 and 13 are more effective than abstract similarity pairing or blindfold chess activities; however, all respondents commented that all tasks will continue to help them become a better chess player and student thinker.

When participants were asked to describe the role of chess in their ability to anticipate dilemmas and generate solutions in other areas of life, most respondents stated that chess had

improved their ability to anticipate dilemmas and generate life solutions more than any other

curricular and/or extracurricular activity. Students cited several examples of social interaction

amongst fellow club members and how such interaction challenged them and consequently

forced them to increase their cognitive capacities and abilities. Their experiences in the MHHS

Chess Program are vividly documented in their reflections and expressions. Each participant's

experience is that of a collective nature as they live and learn within a distinctly unique

intellectual community. Working together, sharing ideas, learning from each other, having fun,

independently learning, increasing their cognitive functioning, and visualizing were the most

frequently cited reasons for participating in chess club. Some students stated that chess is the

primary reason for the academic and school success they have experienced. Two students

predicted that chess club enrollment will increase and that chess will continue to grow within the

community.

Each interviewed student believed that all club members have had individual but

sometimes indistinguishable experiences in the MHHS Scholastic Chess Club, where each

respondent answered the questions similarly. The language is evident of the chess culture, a

culture that fosters abstract cognition. Analysis of the interviews, observations, and simulations

continues in the interview analysis portion of this research publication.

Interview Analysis

Qualitative analyses do not adhere to nor do qualitative researchers prescribe to static and

stringent protocols but rather opt for freedom of both investigative and interpretive methods

(Creswell, 2002). The interview analysis was implemented and exercised in a hybrid fashion

such that there was no clearly identified or standardized theoretical approach to understanding

and analyzing the data. Creswell (2002) finds that the approaches to data analysis espoused by

qualitative writers vary considerably. Tesch (1990) finds some 26 varying approaches to the analysis of qualitative data. Punch (2006, p. 169) states: "This variety of approaches underlines the point that there is no single right way to do qualitative data analysis -- no single methodological framework."

Charmaz (1983, p. 111) states the following:

Coding, the initial phase of the analytic method, is simply the process of categorizing and sorting data. Codes then serve as shorthand devices to label, separate, compile, and organize data. Codes range from simple, concrete, and topical categories to more general, abstract conceptual categories for an emerging theory. In qualitative coding, researchers develop codes out of their field notes, interviews, case histories, or other collected materials. Codes range from lesser to greater complexity as the analytic process proceeds.

This study's coding allowed for the identification of shared themes among the observation, interview, and simulation protocols. After identifying the emergent themes, the researcher continued the iterative process by grouping commonalities and recurrent thematic units. The iterative code mapping is detailed in Table 4. The data were continuously reduced by three iterations of the data throughout the research process. The first iteration identified the initial codes and surface content analysis, the second iteration lead to the formulation of themes or pattern variables, and the third iteration was concerned with the application to the data set. During analysis codes were treated as conceptual categories as they were developed analytically by the principal investigator who defined them carefully. Further, the researcher delineated their properties, explicated their cases, demonstrated the conditions under which they operate, and spelled out their consequences (Charmaz, 1983).

Interview Results

Specific and directly relevant quotes from the interview transcripts are made available in the following block of Chapter 4 supported this study's process of acquiring results. Such transcripts are used to evidence and support the emergent themes extracted by the study's principal investigator. Informed consent, minor assent, and parental permission were received before beginning interviews with an explanation of the study's goals and objectives. The five participants were individually informed in both written and oral forms that the purpose of the study was to understand the phenomenon of abstract cognition via a variety of interview, observation, and simulation tasks. A completed interview required the participants to answer questions and to complete simulations as the researcher observed and noted relevant information.

Research Question 1

How do scholastic chess players describe their experiences in the MHHS Chess Program? (Central Research Question)

A Culture of Self-Regulated Learning. When asked to describe the average chess club member's experience, James responded:

> The Mountain Heritage Chess Club? Um, I can't really say that I know for sure. I would guess most are below the 1000 point mark. Club level is generally 1600+, though. Their experiences are probably the same. I would imagine that they study chess on their own outside of chess club and enjoy playing with each other on Thursdays. Chess club is challenging for some since many are learning how to play the game and here you have players that are actually strong 1600+ USCF.

Edward approaches both the world and life intelligently and confidently since participating in chess club:

I think I explore the World smarter than I did before because I'm able to consider all the variables. Whether the variables be many or few just like in chess I can see all the potential outcomes, the potential events, and chess has taught me that learning is essential because you'll either learn or perish especially with competitive play. Because, um I know that my friends in chess club are getting better and better and if I'm going to continue to compete with them and beat them as often as I would like, then I'm gonna have to learn, and I think for me that's the biggest thing with exploring the World since chess. I explore the World as someone who gets it, as someone who realizes that learning is essential to life, and that, that learning makes life easier because you will make better decisions, you're better informed, um, and you realize that all things in life, all things in life and your life experience is an endgame of an opening and a middle game. And sometimes I feel that through learning, you can better your opening because sometimes I feel that some of us open life with um good moves and some of us begin life after our parents or maybe ourselves have made several bad moves. The middle game is the meat and potatoes of life, it's where we make judgment calls, make choices, um to attend college, to attend some kind of work training, to postpone immediate gratification, to um, I don't know, get a good job with insurance, postpone marriage, because that decides the endgame. And in chess, your endgame doesn't begin with the end, it begins with the opening, with your first move you should have an endgame in mind you should have what you want in an endgame in mind. Do you want a three pawn to two pawn advantage on the kingside, do you want a pawn and bishop ending versus a knight and pawn ending, and do you want a two rook ending versus a queen ending. What do you want? Well it begins early on, it begins early in life. What was the question? Okay, I

guess I just take a learning approach to living life. I learn from my mistakes just like I

learn from my mistakes in chess and I try to fix that. And I'm more open to learning new

ideas and things and just like in chess; you have to force yourself to take a different

approach or style if you want to get better. So it's not about just finding a comfort space

or a comfort level, it's about exceeding your expectations, by learning, by not being

scared to try new things just like in chess. So in addition to being smarter I guess you

could say I'm bolder in my approach to living a good life.

Socialize in a Competitive Environment. Jerelene's response represented the collective

sentiments of Carly, Edward, and Junior:

Well I think it's, I know its individual but it's kind of like the same I guess. I know I

love it and everyone seems to enjoy it and love chess almost as much as I do [laughs], but

although we have fun and we socialize and everything it's still a competitive

environment. People are there to learn, to make friends, experience new things, but they

are also there to win and it's that competitive spirit that drives me to improve and get

better. Like, I know that we uh, since starting chess club we're getting so much better

and I guess the average club member, yeah, we're all getting better and it's been an

awesome experience. I've enjoyed it so much! I think at first we were a little hesitant to

learn new things and chess because it is kind of scary at first because there is so much to

learn. The teacher really broke it down and just allowed everyone to experiment and

learn the game on our own time without a lot of instruction and once we learned it then

yeah, we could study more in depth and a lot of us are competing in tournaments now and

winning so that's really all of us… I think they're like over thirty people. I don't know

everyone but I know enough to be able to talk about the average I guess, the average

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person. Like, the average person loves chess club. It's fun, it's challenging and we all love to beat each other.

James discussed how he has changed since participating in chess:

> I have grown accustomed to studying independently on thechesswebsite.com, video-lessons by Grandmaster Roman Dzindzichashvili and others. Before participating in chess, I did not read as much. I read all the time now although it might not be great works of literature, but I do read chess books. I am not exactly the most competitive person in chess club, but I do enjoy an occasional win. It is good for the ego, you know? And seeing as to how I'm not as strong as the other players, I do study chess during my fourth period media services class in the media center. Studying seems to help. I also believe chess has helped my art since I'm more into the visual beauty of a good chess match and not so much into book theory like the others.

James continued: "... When I am in a particularly chess-heavy mood, I tend to see the world in a series of actions and logical reactions. Before chess, I wasn't aware of this."

Jerelene, too, has changed:

> I think that I'm a much better thinker and I'm more patient. Uh, maybe a bit more outgoing at times since making the most of chess club requires you to interact with like, people you may or may not know. I think I make better no wait [laughs] I'm pretty sure I make better decisions now because I think about the consequence of my actions just like I do in chess. I try to think ahead as much as I can, like I don't always, but I try to at least and before chess I didn't do that. Before chess, I was very reactionary to my environment and to people in my environment. So now, I can think ahead and may if I think ahead and decide that something is not the best situation to put myself in, and then I

may, wait… I won't go. So, if one of my friends invites me over to an unsupervised

party, then you know after chess, I know that that represents a potential danger or

unknown. And now I can sort of see the interconnectedness of events now. I now realize

that my actions are you know, not actions in a like a vacuum. My actions have

consequences, real consequence for real people and most of all, consequences for myself

and others around me just like each chess piece. And I really haven't thought about this

until answering the question, but I'm a think better solo thinker, but I'm also a better

team member because pieces in chess are more powerful when you use them together and

when you have a plan. So yeah, I've learned a lot and I've changed a lot since

participating in chess club. Academics? Um, like I think I'm a better student and citizen.

I think I'm more responsible for myself now. I make sure to complete classwork and

extracurricular activities early so I can use Smart Lunch solely for chess because I hate

missing chess club [laughs]. So, I make sure that my grades are where they need to be

since I'm trying to receive scholarships and stuff. And, I think that chess helps me with

my studies. I'm more analytical and critical now and this helps me in math and the

natural sciences. Believe it or not, I'm much better in English Language Arts. I'm able

to read a passage and retain the information much better, and I'm like better at looking at

the plot and being able to analyze it better. I'm better at identifying and understanding

the protagonist, the antagonist, the mood, the setting, the theme and all literary elements.

Research Question 2

How do scholastic chess players demonstrate their ability to conceptualize hypothetical

scenarios and ideas?

From Concrete to Abstract. All five participants evidenced an ability to conceptualize hypothetical scenarios and ideas as evidenced by their interview responses; however, the participants exhibit varying levels of abstract thought. Interview questions 8, 9, 10, 11, 12, 13, 14 , and 15 supported the researcher's investigative efforts as such questions support the theoretical ideas aligned with Research Question 2. The emergent theme of an evolving cognition from Piaget's Concrete Operational Stage to the Piagetian abstract or Formal operations stage was extracted from both the observation and simulation protocols.

Consider Junior's game as he plays as Black while prescribing to the classical chess school of center pawn occupation: 1.e4 c5 2.Nf3 d6 3.d4 cxd4 4.Nxd4 Nf6 5.Nc3 g6

Junior's responses were indeed well-reasoned as his defensive ideas, potential counter offenses, and Sicilian initiatives were evidently displayed. Suspicious that Junior may have responded to the principal investigator's standard opening as White with rote memorization such as Sicilian book lines and opening theory, the researcher implemented interview question 9. Question 9 began with the rather ambiguous move of 1.Kf3 as the investigator initiated a secretive flank opening attack as White. Junior's responses were both within the rules and available; however, the ideas behind the moves were relatively weaker than before. This observation is analyzed and discussed in Chapter 5. Carly and Jerelene have lost to Junior during sighted play; however, their responses to all three blindfold observational and simulation tasks were considered good moves at an incredible depth of analysis. Consider Carly's blindfold play as she opened with 1.e4 e5 2.Nf3 Nf6 3.d3 Bc5 4.Be2 O-O 5.Nc3 d5 6.exd5 Nxd5 7.Nxd5 Qxd5 8.Bd2 Nc6 9.c4 Qd6, and White has gained both control of the center and tempo on Black. Overall, the participants' ability to conceptualize logically sound moves and positions during blindfold chess play is an excellent indicator of abstract cognitive phenomena. Consider

Jerelene's hypermodern Pirc Defense to White's 1.e4 opening: 1.e4 d6 2.d4 g6 3.Nc3 Nf6 4.f4 Bg7. The line is logical enough and evidences both anticipation and pattern recognition although the two are neither analogous nor indicative of each other. There emerged a difference between anticipation and pattern recognition during the observation, interview, and simulation tasks.

Three of the five respondents were able to develop and construct past potential lines or possible sequences leading to unique chess positions (interview questions 11 and 12). Both Edward and James seemingly lost interest during this phase of the interview although Edward evidenced the prerequisite cognitive abilities during previous simulations. For James composing potential lines and sequences on paper was not the fun and engaging competition or the chance to talk about something of interest. Writing down hypothetical scenarios was too reminiscent of seatwork that James loathes. James stated: "Mr. Laws this isn't chess, I mean where is the fun?" James continued: "Ugh, I'm sorry, but I don't want to do this. I love chess when I'm playing an actual opponent or like myself. But this, this isn't fun [James laughs]." When asked why, James responded:

> It isn't challenging enough for me I suppose, I mean, I'm not really playing anyone and I like to understand the essence of each position that I see and understand the reasons behind my moves. It's hard to explain this verbally, but sometimes, uh, I like to look at each piece and ask myself if I could move this piece to anywhere on the board, then where would I move it. So, when I answer that, I go ahead and try to get the piece there after thinking of some potential ways. I mean, I don't want to do that right now.

James conceptualized the chess sequences and lines differently than Carly, Jerelene, Edward, and Junior. From the analysis of James's textual account it is determined that James is in transition from Piaget's Concrete Operational Stage to the Piagetian Formal Operations Stage

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and/or abstract cognitive phase. James's response to interview question 11 evidences this as he concretely examines the board but has evidently considered potential lines and sequences and/or the derivation of such lines and sequences as he states: "It looks like this position has arisen from some variation of the Queen's Indian. I don't know of any other that could result in this." Upon completing question 11, James then responds to interview question 12: "This one is odd. From what I can tell it looks to be some strange variation of the French Tarrasch where white neglects to play d4. Or perhaps a weird version of the Alekhine? It could even be the King's Indian Attack." James evidences a burgeoning abstract conceptualization and pattern recognition. James continues:

> As far as pawn structure, White looks to be better in both, due to the lack of Black's
>
> light-squared bishop. Black does seem to have a sizable advantage in the left situation,
>
> though, because of the much more active placement of his King.

The interview, observation, and simulation tasks supporting Research Question 2 produced rich and insightful data as to how scholastic chess players demonstrate their ability to conceptualize hypothetical scenarios and ideas. Respondents were able to express and evidence an emergent theme by comparing and contrasting concrete and abstractly theoretical positions (interview questions 13 and 14) and by identifying concrete and abstract pairs from four positions. The thematic shift between the Concrete Operational Piagetian stage and the purely abstract were evidenced as four of the five participants were able to identify concrete pairings or similarities, abstract pairings, and comparable or contrasting positions. This study's interview questions were designed around the concept of abstract similarity and supported Research Question 2 by producing rich textual data (Bilalic et al., 2007; Linhares et al., 2012).

Blindfold Chess and Abstract Similarity. Student participants were able to think abstractly as evidenced by their understanding of both the structure and form of the presented chess positions. Chess players were able to reverse-engineer potential lines and sequences, albeit some better than others. Interview questions 8 through 10 required each participant to engage in blindfold chess play to illuminate abstract phenomena and evidence higher order cognitive functioning. All five respondents were able to vocalize opening moves or the first sequence of initial moves during their chess matches. Granted, some moves were more logical and theoretically superior than others; however, the central ideas although not vocalized, were indeed evident on the board. Both Junior and Jerelene were able to respond to the investigator's opening with nine moves before blundering and/or losing their visualization of the invisible chess sequences and moves, whereas Carly was able to continue play through the middle game before reaching critical visual-spatial capacitance. In responding to the abstract similarity themed questions, James replied with the following:

> They look more even in light of the fact that they have opposite-colored bishops with all
>
> of each side's pawns on the opposite color of their opponent's bishop. Drawish, even.

James continued to struggle with the transition between the concrete and the abstract as James stated the following:

> I am unsure of the question. If you imagine the boards to be laid out on a coordinate
>
> plane, with each board representing a quadrant, boards 1 & 2 share the fact that both sides
>
> have same-colored bishops, while boards 3 & 4 share the opposite. Boards 2 & 3 are of
>
> similar pawn structure, just as boards 1 & 4 are.

Research Question 3

What are the cognitive processes that scholastic chess players use to anticipate potential

outcomes?

Anticipation vs. Pattern Recognition. James evidences pattern recognition ability upon studying

the board and considering the presented concrete scenario. James stated:

> I am familiar with the Legal Trap. White first takes with the Knight on e5, exposing the
>
> Bishop to a discovered attack by the Queen. If Black blunders and takes White's Queen
>
> sacrifice, the moves: …Bxd1, Bxf7 Ke7, Nd5#, and then he is winning. Instead, if White
>
> takes the Knight offered on e5 with the series of moves Nxe5, Qxh5 Nxc4, Qb5+ c6,
>
> Qxc4, then this leaves White up a minor piece for a pawn and clearly winning.

James continued to state that he believes that the move order given in the interview is incorrect;

however, James doesn't seem to realize that this is only a derivation of book theory. James

stated the following:

> The move order given is incorrect: 1.e4 e5 2.Nf3 c6 3.Bc4 d6 4.Nc3 Bg4 5.h3 Bh5 2...c6
>
> should read: 2...Nc6

As James continued to identify patterns and seemingly presumed to synthesize such patterns into

existing chess theory:

> Move 14 should read: 14...Nxf3+ I believe. Well, move 24 certainly would have come as
>
> a shock, and I'm surprised there is not an exclamation in the notation. I analyzed the
>
> dxc5 line, which leads to a fork on Black's Queen and Knight, if my analysis is solid.
>
> Pushing forward on the King's side seems like a logical way to fight for compensation of
>
> the pawn, unfortunately, I simply don't see it. Black's Queen is passive and moving far
>
> too frequently, the light-squared bishop is not doing anything and the isolated Queen's

pawn leads to some structural problems down the line. I would have been disheartened, to say the least.

In responding to interview question 5, James exhibits an ability to taxonomize lines and sequences such to identify patterns and ideas; however, pattern recognition may in fact be a more pragmatic extension of anticipatory cognition. Consider James's response:

The passed pawn is nothing to worry about, White can attack it with the Bishop, forcing Black to defend with his Bishop, but because of the poor placement of Black's Rook, it will be difficult to find compensation for the pawn after White's Rook moves to a1.

James continued evidencing a certain synthesis of pattern recognition and anticipation of all things unseen by responding to interview question 6:

Black needs to either drop his Rook back to the eighth rank or push it to attack the pawn on d4. If anything else is played, the passed pawn on the A-file is left with only a single defender and is soon to fall.

Cognitive Paradigm Shift. Choudhury et al. (2008) find that assuming someone's perspective and thinking about how someone must think and feel requires a developed social cognitive level. Further, imagining someone making an action relative to one's own perspective is associated with a higher cognitive level (Choudhury et al., 2008). Student participants exhibited formal operational thinking as defined by Piaget by thinking abstractly and partly evidenced this by reasoning contrary to their very own chess position. The participants playing as White were able to describe Black's perspective with descriptive and well-reasoned language. When asked to conceptualize and accurately describe what it might have been like to be Khomyakov and down a pawn or to consider the opponent's thought processes, Carly stated the following:

Okay, um playing as Black, I'm analyzing the board now [long pause]. Um, I don't think all is lost [long pause]. I know that Black is down a pawn but he does have a passed pawn on the A-file with the pawn being at A6, so if I were Black, I would try to protect that the best that I could and try to get it somewhere where I could promote it because White doesn't have any passed pawns and that would be Black's only redemption to promote the pawn so I guess, I could, I mean this is just a hypothetical, but I could work on promoting the pawn so A6 to A5 and then White would probably, White will want to challenge that by moving his Rook on E1 to A1 attacking that so my only hope would be to move to A4 and allow my Bishop to protect that and Black would then… well that wouldn't work because then he could move um, then he could move his white squared Bishop to D1 and then he is attacking the same piece with two different pieces with his Rook and his Bishop and there is no way I could defend it with my Rook. I guess I need to go back and reevaluate this a bit [simulating the move over-the-board]. So, here is the Rook [simulating the move over-the-board], okay so yeah, I feel good about my idea to promote the A6 pawn. I'm going to bring my Rook back to F8 and he will probably try something cheap, he will probably try to move his white squared Bishop to uh E2 and that is when I will move my Rook to A8 and he will probably move his Rook to A1 and now he is attacking the same piece twice but that's okay because I have options now that I can see. I can move my white squared Bishop to C8 and protect that or I can promote or not promote but move from A6 to A5 and what that would do, that would prevent, that would render his white squared Bishop useless because my pawn is on a black square and his Bishop is limited to white squares so he can never attack that and I can leave it there and see what happens. I can even move down to A4 and he really can't do much here I

mean it's just a wasted move if he moves to D1 because he may be attacking that piece with two pieces, but I'm defending it with two pieces so victory is mine. Um, if he does do that, I would just move the A pawn from A4 to A3 and [long pause], I would eventually try to work my Bishop in to put pressure on the A1 square because that's a very weak square. The A1 and A2 I think, those are mine for the taking so what I would probably do now, I would um well; it's his move isn't it? He does have options but they're not good. So hypothetically, we say he tries to bring in support with the white square Bishop to B3 and then what I can do, I can force a move so there we go with the forcing stuff. I can force a move by taking my white squared Bishop and forcing an exchange if he takes then I would just take him and then I'm down to a Rook versus a Rook and a pawn. I'm feeling good about my chances now um because what I want to do, I'm going to advance. I'm not exactly sure about what he is going to do. I'm sure he's going to try to leave that alone and he's going to try to bring his King over to support the square and he will move his King probably to E2 and then I will move to A3. He will probably support the pawn there and I will move to E5 so there are a lot of options.

Edward and Jerelene expressed similar thinking in response to the first set of interview questions, especially when asked to assume a different perspective and to describe what it might have been like to be playing down a pawn as Black in interview questions 4 and 5. Edward stated:

I'm pretty sure that I have seen a similar position before I think. Um, whatever, I recognize the structure and overall pattern of the match. Khomyakov should be feeling hopeless once he realizes that he is in a lost position because all White needs to do is um,

attack. White should focus on attacking the Black pawn at A6. If White can win the

passed pawn, then he might choose to use his own pawns. Uh, I think once White begins

to zero in on the lone A6 pawn and the lone D6 pawn, and the vulnerable Bishop at D7,

Black doesn't have an answer to all of that. From what I can work out is that all Black

can do if White moves Rook to A1 is to move Bishop to A5, but then all of White's

pieces are active and Black's Bishop is married to that stranded pawn and Black's Rook

is in a crap position. No, Black should be down on himself because I can't see a fairy-

tale ending for Black.

Anticipating Potential Outcomes. Research Question 3 was supported by interview

questions 1 through 7. Questions 1 through 7 were windows into the participants' cognitive

processes during anticipation of potential and hypothetical scenarios or events. Carly, Junior,

Edward, and Jerelene similarly expressed their cognitive processes within a specific framework

of descriptive nomenclature. Respondents described their thinking within the context of

anticipating potential outcomes and/or hypothetical scenarios. Carly, Junior, Edward, and

Jerelene evidenced future events with the use of imagine, see, visualize, and If/Then

statements. Visualize was cited by all five participants and was the most used transcribed word

associated with Research Question 3. In verbalizing her thinking throughout White's sequence

of taking advantage of Black's positional play and White's potential mating sequence, Carly

stated:

I'm looking at the board and I see sound development by White and weak development

by Black. I'm trying to identify with Back. And what I mean by that is Black's white

squared Bishop is unprotected on the H-file and his King is vulnerable to attack by White

and I see that uh White's Knight on F3 is pinned to the Queen uh at D1 but I could, I

think at the very least that I could win material here by initiating the sequence as White's F3 takes um E5. So, if that happens, Black's potential options that I can, that I can visualize, would be he recaptures with his Knight on E5 which would be um one of his better moves or he takes my Queen at D1 and if he captures the queen at D1, then I think it's going to get really unpleasant for Black as I can then initiate a checkmating sequence with my white squared Bishop at C4 takes F7 which would put the King in check and he would then have to retreat to the only place that he could which would be E7 and then I could just mate the Black King by moving my Knight on C3 to D5, and that would be checkmate. That would be Black's worst. Worst move would be to, I guess fall for the trap. I'm not sure that it's a trap per say, but he could he could fall for the trap and that's the beauty in that move by White and if he wanted [long pause] his better move would be [long pause] if he recaptures with his pawn at E5 then I, I win material. I win his, I win his Bishop on the H-file outright and worst case for White would be, is if I capture with my Knight at E5 and he recaptures with his Knight. He recaptures E5 and then I take the white squared Bishop at H5 and if he takes my white squared Bishop at C4, then I can put him in check with my Queen at B5 and then recapture his Knight because he can't move his Knight to protect or to uh protect the King from check and I win material again. I'm up a pawn and worst case for White, I'm up a pawn. Best case for white, I win by check mate. Worst case for Black, he loses a pawn or I'm sorry, he is checkmated and best case for back is he's just down material, he's down one pawn.

Edward explained his thinking similarly as he uses If/Then logic statements and meaningful words or phrases rich in phenomenal language as found in the literature review:

White should focus on attacking the Black pawn at A6. If White can win the passed pawn, then he might choose to use his own pawns. Uh, I think that White would feel happy to trade his pieces for Black's pieces since he has a three pawn to a two pawn advantage on one side of the board and possibly a two pawn on one pawn advantage in the center of the board. So if White activates his Rook by moving to A1, then Black could possibly move his Bishop to D8 or um, maybe B5. So, Black protects this one pawn. White would probably want to move his Bishop to E2 to attack the Black pawn and White is now feeling very happy. If White does this, then Black could potentially attack the D5 pawn, but Black should probably quit playing because he can't win anymore because Black is down two pawns and Black's pieces are sort of trapped. I can't see how Black can win after losing the A-pawn. Give me a second and I can make sure, I just need time to think about it so I can see all the possible moves [long pause]. Yea, I can't visualize a pretty ending for Black.

James stated that he anticipates visualized best moves rather quickly; however, he consciously slows the pace to ensure he makes the best decision:

The processes that I use to anticipate potential moves is that I first look at the present situation presented on the board and then I visualize potential moves by seeing what each piece needs to do to mate, uh, to win exchanges I guess. For White to mate Black with the scenario on the board, Black must play along and play into the hands of White... Black can't be greedy because if Black takes White's Queen, then Black will mate with Knight to D5. That's it really. White isn't guaranteed a win here, but White does have a visible advantage I guess, and I don't anticipate Black winning or even breaking even.

When asked to describe their conceptual processes used to describe potential outcomes, all five participants used similar phrases, words, and exhibited standardized models of conceptualization and cognition. One particular respondent has participated in scholastic chess for several years before enrolling in the MHHS Chess Club. There is a certain correlation between the amount of scholastic chess participation and the content of the participants' cognitive descriptions as evidenced by the textual data. Three participants with markedly lower scholastic participation rates responded similarly to the interview stimuli. It appears that the more scholastic chess participation a student has had, the better the conceptualization skills are in anticipating potential chess moves, ideas, and problems. In anticipating her opponent's potential chess moves, Jerelene stated:

> You know, it's like thinking about what could happen if I do this or this. But, it's like more than that I guess. So I try to imagine at least three, four, or five moves ahead and I guess you could call that like anticipation. Sometimes I get it right, sometimes I think correctly and my opponent does what I thought they would do and I move like here or here.

Jerelene continues:

> … When I'm thinking of possible moves, I like, see the possible moves in my head. I can visualize the part of the board where the possible moves will take place. I mean, I only see what I need to see. So, if my opponent is trying to put together a diagonal attack with like a few minor pieces, then I only worry about trying to like, see those squares and pieces in my head. It's easier that way, you know?

Junior described his conceptualization of possible scenarios:

Well, it's like war. You have to guess what the enemy will do, but you have to be able to

guess all the possibilities. When I think of possible scenarios, I visualize some of the

board and try to recognize my enemy's patterns. Okay, if he wants to beat me by say a

combination of several moves and pieces, then I try to run that situation in my head

because I hate losing. When I try to visualize a pattern or something like an attack with

my own pieces, it's like I see super basic images flash through my head. Uh, okay, I

remember the question now. How does chess apply to my life? I use chess thinking all

the time; I use it when I play video games, when I have to make an important decision,

and I use the thinking of chess to make decisions like which classes to take or if I act out

a thought or something. Like if I get mad at someone and want to fight them, then I have

to slow down and think about the consequences just like I do in chess.

Interview question number 5 supported Research Question 3 by requiring the interview

participant to think of potential or hypothetical scenarios via a paradigm shift or a change in

perspective. Carly stated:

In chess if you have positional superiority you try to exploit your opponents position if

you have piece superiority then you typically try to exploit the material differential.

When I look at this I see that I'm up a pawn and he is a pawn down and I want to try to

exploit that and I want to prevent Black's Rook from becoming active because when I

look at this, when I visualize the board, his Rook isn't as active as he probably would

like. Um, if it's my move [pause] I know that I would probably move to E7 and attack

his Bishop immediately and his only or his only option would be to move to F7 himself

and hope for an exchange which I would not give or yeah, I would probably give him that

because I'm trying to eliminate um, trade his pieces and exploit the material differential

so that's a hypothetical scenario. Um, something else I can visualize would be if he doesn't do that, then he will probably retreat his Bishop to C8 and try to protect that link up and then I would go to A7. I see the lone pawn as being very weak for Black and personally I would try to exploit that. I would try to exploit the fact that his, he has weaknesses, he has two lone pawns essentially at A6 and D6 and I think eventually that those will fall. I may have to do some forcing moves.

In response to interview question number 6 and the importance of activating Black's Rook, Carly continued:

A5 simply loses for Black um because as you advance from A7 or excuse me from A6 to A5, then that opens up a line of attack that Black cannot defend. For example, um White can move Rook to A1 and his only you know Black's only hope now is to advance the pawn further and if he does that then White simply plays Bishop to A,B,D, D1 and here he is attacking the pawn on A4 not one but two ways. He's attacking it one way with the Rook and then the Bishop whereas Black is only defending that so um Back loses a pawn. I mean best case, White takes with um Bishop and then Black can either choose to take the white Bishop or not let's say he does take it then that exchange through this exchange White is now up another pawn for a total of two pawns. Now you're looking at an active Rook and 1,2,3,4, 5 pawns versus 3 pawns and an inactive Rook. And to activate this Rook it will probably take more than just one move because I really don't see him being that active because now if you do try to activate the black Rook the white Rook can easily go to A6 and attack the pawn on D6 and that would create big trouble big trouble for Black because now you can just advance your pawns and take control of your material advantage and take advantage of your material advantage.

Carly's textual account of forward search and anticipation are similarly shared by Junior, Edward, and Jerelene. Carly and Jerelene did not simulate nor did they move the chessmen as they worked through a conceptual solution, thus illustrating forward search and anticipation all the more. Although the researcher refrained from simply counting specific words, the consistent usage of such words with a relatively high frequency should be noted. Paralleling Carly's conceptual processes, Junior explained his cognitive processes in his response to interview questions 1 and 2:

> The worst case for White is he wins a point and he leads with points. So Knight takes E5, so this is the best move. The King is in danger here cause the development is not like built up. So if Knight takes E5, then Black can move his Bishop back to G6. But, White may take the Bishop so worst case for White is that he is up material. Most people would take the Queen with the Bishop, but the White C4 Bishop would take the pawn on F7 and put him in check and Black's only move would then be up one to E7 because if he moves here, he would be involved in the mating sequence. So I can see checkmate is best case for White although it is kind of hard to visualize. Black is weak here in this position because White occupies more of the center than Black occupies and Black has less development.

Carly did not choose to simulate any hypothetical over-the-board but rather abstractly conceptualized such potential scenario. Carly described her thought processes used to anticipate potential outcomes such as exchange sacrifices, simplifications, and calculations:

> Okay, in chess play or when I'm playing chess you don't get to simulate potential moves over the board so you're going to have to think about them um I guess that's what I need to do now, but I always consider the what-ifs before I make my move. I noticed the more

I play chess the quicker it is for me to identify the best move but before I actually make that move, I want to make sure that I'm not making a blunder or I want to make sure that the move that came to me quickly is actually a good move. When I look at any chess position or chess sequence or I'm thinking about a chess sequence, I first look at the um board as a whole and um… I imagine moving the pieces before I actually touch a chessman or any of the chessmen and I guess you could call it cause and effect. I think about the cause and the effect. An Exchange sacrifice I would call that um [pause] anytime you have an exchange sacrifice those usually occur because you have forcing moves and a forcing move is uh typically a move that puts the King in check so when going back to the this sequence. When I put the King in check with my white squared Bishop after taking the pawn at E what was it? E5? That's a forcing move and that helps me initiate the exchange sequence but like I said I can't actually do that on the board. I have to think about it before I make the move so my thought processes I guess cause and effect, what-ifs, I can make the moves here on the board and I suppose sometimes it's easier to visualize a forced move or an exchange sacrifice or any other chess tactic or strategy (i.e. calculation simplification). Yeah it would be easier I guess if you could move the pieces during a match before you decided but you can't do that so I have to think about it in my head and when I think about it I, I just think of chess in terms of safety and danger and threats and immediate threats and mortal threats. It's kind of like battling and when I visualize this in my head I don't really, I don't really see the entire board or I don't see the actual chessmen I guess. I see um I know where they're at and I know where they can move and I know where threats are coming from if that makes sense because I can't waste space trying to keep all of those photographs in my mind of

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the position. I have to simplify it somehow kind of like going from 3d to 2d just less

detail I guess.

Research Question 4

How do scholastic chess players describe the role of chess in their ability to anticipate dilemmas

and generate solutions in other areas of life?

Visualizing Actions and Reactions. James explained the role of chess in his ability to anticipate

future events, to visualize life problems, and to find solutions. James stated: "I think it has

helped tremendously. The ability to visualize actions and reactions piece-by-piece is invaluable.

The ability to organize my thoughts efficiently and not repeat myself has improved my mental

speed." In responding to interview question number 17, James succinctly stated: "I think that my

ability to retain information has improved dramatically and my ability to process and utilize that

information is much more efficient."

Carly similarly responded:

> Okay, um, I think that chess is really just that, anticipating dilemmas, generating
>
> solutions and uh making good and reasonable moves. I think that anyone can improve
>
> any area in their life if they apply themselves in that particular area. If you want to be a
>
> better thinker and have a life built on good decisions, then you need to train and increase
>
> your skills and abilities to do just that. Um, chess club is essentially a place that I go to,
>
> to learn and improve because it's fun, but also very enriching. The role of chess in
>
> anticipating dilemmas and generating solutions is big. Um, I have changed my way of
>
> thinking since playing chess and um, I am making better choices. Like, I'm making sure
>
> that I take college credit and AP courses because I'm thinking ahead because I uh, want
>
> to become a professional, maybe an engineer although I haven't decided between

mechanical engineering or nuclear engineering. But yes, chess plays a role each and

every time I have to make a choice or think ahead.

Identifying Possible Solutions. All five respondents expressed varying scenarios and events;

however, the underlying theme remained the same. All five chess participants exercised the

abstract phenomenon manifesting from chess thinking, such to address a decision that was

grounded in the context of reality.

Jerelene stated:

> I'm pretty sure I use chess thinking all the time in real life. I guess the last time I used
>
> the same thinking as I do in chess would be uh yesterday during my dual enrollment
>
> class. So, during class, we were asked to respond to like a current event issue involving
>
> potential energy sources. It was kind of like a seminar type format and there were five
>
> groups presenting that night. Most people were like 'yeah that sounds like a brilliant
>
> plan,' but they failed to think about what it would be like if we actually had that
>
> technology in our backyard. They were just responding to a few boring facts on the
>
> presentation slides, while I was busy trying to think about the potential benefits or worse,
>
> like all the bad things. So I had to point out and give concrete scenarios for some of them
>
> to change their mind. It worked because three people changed their minds and they were
>
> not blindly agreeing anymore."

Junior's response was increasingly similar to the responses of Edward, Carly, and James. Junior

responded:

> I use chess thinking in school all the time, but my favorite thing to do is to play online
>
> multiplayer games. My favorite types of games are first person shooters and online
>
> multiplayer games give me large maps, large battles and a lot to think about. Just like in

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chess, I look at the map and try to like identify enemy troop movements and patterns, so I

can come up with a plan of attack or sometime setting up a defensive perimeter. And

then I have to run through my head all of the possible tactics and strategies that my

opponents will try and chess has helped me visualize all of these potential attacks and

defenses, and possible outcomes.

Summary of Data Analysis

Coding is the process of categorizing and sorting data is not itself, data analysis, but

rather a supportive element in the qualitative analysis process that was used in this study

(Charmaz, 1983). The most serious and central difficulty in the use of qualitative data is that

methods of analysis are not well formulated (Miles, 1979, p. 591). This study's qualitative

coding method is analytic as it systematically created categories from the researcher's

interpretations (Glaser & Strauss, 1967). The researcher opted for qualitative coding with a

distinctive structure, logic, and purpose rather than relying on preconceived categories and

standardized procedures.

The data analysis techniques or analysis methods for this study were systematic,

disciplined, and able to be seen and described (Punch, 2006). Charmaz (1983, p. 111) states:

Qualitative coding is not the same as quantitative coding. The term itself provides a case

in point in which the language may obscure meaning and method. Quantitative coding

requires preconceived, logically deduced codes into which the data are placed.

Qualitative coding, in contrast, means creating categories from interpretation of the data.

The coding process commenced as the interviews began. The researcher fastidiously

transcribed each verbal account of rich and meaningful data. The transcriptions are stored safely

under lock and file and are available for review. This study's data analysis is intrinsically

dynamic as the coding processes transformed with time. Codes served to summarize, synthesize, and sort the many observations made by the investigator (Charmaz, 1983). Iterative coding was the conceptual link between the "data collection and its conceptual rendering," and coding became the "fundamental means of developing the analysis" (Charmaz, 1983, p. 112). Charmaz (p. 112) states: "… The categorizing and sorting inherent in coding are more than simply assigning subject headings or topics to data. Researchers use codes to pull together and categorize a series of otherwise discrete events, statements, and observations which they identify in the data."

This study's stringent data analysis protocol began with the central premise that the qualitative case study investigator was interested in interpreting what he saw to be enacting around him while anchored in dense context (Charmaz, 1983). The data analysis was iterative and emergent as the principal investigator refrained from tabulating explicit occurrences of abstract phenomenal language among five MHHS scholastic chess participants but chose to connect quanta of data as representative of the same phenomenon.

The first stage of the systematic analysis or initial coding process began as the researcher read through the textual representations of the students' thoughts and conceptual processes while simultaneously noting ideas and interpretations. The researcher was focused on understanding what each passage was about, the major themes, and any unique issues or events. Cases were grouped into category types that reflected each qualitative case study research question (i.e. Anticipate hypothetical scenarios and events).

Stage two involved the highlighting, the underlining, and other markings of the textual data retrieved from the student interviews. Points of interests such as inflection points and modulation points of intonation between and among the study's participants were noted and

annotated. Key words and phrases were highlighted and the transcribed data were labeled according to an emergent coding process. The second iteration of the constant comparative model produced several codes as the researcher refined and synthesized textual data.

Stage three was two-part, namely, code reduction and application to data set. The researcher noted the occurrence of a particular theme during stage three of the coding process. Occurrences of a particular topic or theme were systematically coded to indicate the meaning of these quanta or chunks of text. Codes were indexed and reviewed, grouped and organized, and reduced into holistic interpretations of the observed phenomenon. Repetitious codes of abstract cognition among the participating chess players were eliminated. Extracted codes converged to form concentrated packets of meaning seasoned with descriptive verbiage.

Stage three or the third iteration concluded as the researcher finalized the relation of general theoretical ideas to the textual data set. The researcher then artistically interpreted the iterative products to identify both interconnectedness and significance of the findings. Lastly, the researcher reflected upon how the codes related to this study's four qualitative case study research questions and the supporting literature detailed in the literature review. The data were continuously revisited throughout the analysis to ensure conformability.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Discussion

The study findings, the study conclusions, the implications of this qualitative case study, and the recommendations for both practice and further research are discussed and detailed in Chapter 5. Chapters 1, 2, and 3 presented the principal investigator's introduction to the topic, the qualitative case study approach to understanding abstract phenomena among scholastic chess participants, the data production and collection methods, the review of literature, and the chosen research methodology. In addition to outlining and discussing the emergent themes associated with the research questions, Chapter 4 contains both the interview results and analysis. Through clinical qualitative research this particular case study actively explored how one's participation in chess club results in the newfound ability to conceptualize abstract events improves academic and life performance. The rich and textual data collected for this particular study reflect much of the present chess, behavioral, and cognitive research. This study produced data in support of the general consensus among many postmodern chess players that chess is an abstract gateway to an increased cognitive capacity and ability. Further, the data suggest that scholastic chess is both an abstract strategy game and a mode of intellectual improvement conducive to increased life and scholastic success.

Liptrap (1999, p. 5) stated the following:

Previous studies indicating the effects of chess on scholastic achievement have received little notice, and have been criticized for small sample size, or for chess clubs being self-selective elite groups, or for being too anecdotal. Many observations by teachers, parents,

administrators, and students report advantages of participation in chess, based principally upon improved self-image, confidence, and critical thinking skills.

The problem statement, from which this study manifests, is directly related to the lack of replicable and legitimate scholarly research. Much of the present information concerning chess as a tool for learning is considered ad hoc and anecdotal (Liptrap, 1999; Parr, 2011). The researcher aimed to challenge that idea by fastidiously studying the phenomenon of abstract cognition among a purposive sample of five MHHS scholastic chess participants.

The results from this study provide a textually rich framework for understanding and exploring the phenomenon of abstract cognition among scholastic chess players. Found below are the theoretical implications and conclusions associated with this scholarly investigation. The chess participants described their cognitive processes and in doing so, detailed the many faculties of abstract thought as the respondents described their participation in chess club as both enjoyable and beneficial.

As evidenced by their demeanor, the researcher's memos, and the transcribed interviews, the respondents believed their thinking or cognition to have changed since enrolling in the MHHS Scholastic Chess Club. This supports the fundamental premise or assertion that participation in school chess facilitates the centrifugation of a denser and more refined cognition similar to that of international grandmasters and successful lifelong learners. There is a distinct relationship between the level of abstract thought, the success of the chess players, and one's accumulated participation hours.

Conclusions

Four research questions guided this study throughout the qualitative investigation. From the review and subsequent analysis of researcher memos, transcriptions of interviews,

observations, and simulations, the investigator was able to extract meaning such to understand the essence of the observable phenomenon of abstract cognition among the sample. The conclusions and findings may be used to direct future research endeavors and/or used to development educational policy and analysis that will improve the lives and the academic success of American K-12 students. Below, the conclusions for each of the four research questions are provided.

Research Question 1: How do scholastic chess players describe their experiences in the MHHS Chess Program?

All five respondents held a favorable perception of chess club and collectively used emotionally charged language to convey their favorability of the program. The participating chess players in this case study overwhelming described their experience in the MHHS chess program as enjoyable, challenging, fun, and engaging. There is an undercurrent of competition that drives members to study independently if they wish to remain competitive in a burgeoning culture of intellect and self-regulated learning. Winning is incredibly rewarding and fun for the study participants and from this success, the respondents are increasingly confident. The respondents indicated that there is a distinct culture of learning among the club members that is noticeable to the participants and to the school body.

Individually, the results align with the supporting research and scholarly material found within the review of the literature. From the interview, observation, and simulation responses participants described their own unique experiences that collectively culminated into a valid understanding of what it is to participate in the MHHS 9-12 chess program. Although the researcher does not seek to apply the results to the entire population of the chess constituency, the results do warrant a newfound consideration of doing such.

Research Question 2: How do scholastic chess players demonstrate their ability to conceptualize hypothetical scenarios and ideas?

From the analysis of the researcher's memos, it was found that the respondents exhibited a certain and an apparent eagerness to engage the presented stimuli. Additionally, the student respondents were pleased to vocalize and simulate their conceptual processes during the interview as they reacted to chess questions and simulations. While responding to the interview questions, the students again evidenced behavioral and emotional engagement in both rationalizing hypothetical moves and finding winning strategies or ideas.

Data from the three data collection protocols revealed that four of the 5 students have completed the transition from Piaget's Concrete Operational Stage to the Formal Operations Stage as evidenced by the data. Carly, Jerelene, Edward, and Junior consistently conceptualize and process in the abstract when playing chess. However, this abstract ability is oftentimes called upon only after analyzing the concreteness of a given position, a chess line or a sequence. James's conceptual processing is transitory as he navigates along the continuum of increased abstract cognitive ability when an encountered stimulus demands such movement.

The theme of cognitive evolution between the concrete and abstract stage is apparent in all five research cases. Each respondent evidenced similar but uniquely varying skills and abilities when conceptualizing hypothetical scenarios and ideas. This marked change in cognition was best exemplified during blindfold chess play. Here the participants' responses were rational, theoretically appropriate, and perhaps most importantly entirely hypothetical and abstract. Because there was no sighted play nor a tangible board and chessmen, the students were forced to visualize development, lines of attack and defense, all the while remaining blindfolded. The ability to participate in blindfold chess play evidences a higher cognition that

extends beyond the concrete operational stage. Blindfold chess play is found to be an excellent conduit to study abstract thinking as a phenomenon. Although Junior's response to 1.e4 was found to be reactionary to rote memorization, his responses to the flank openings were not as strong but wholly a product of his own abstract cognition. Jerelene, Edward, Carly, and James evidenced an ability to think abstractly while completing the blindfold task. Junior has beaten Carly and Jerelene in the past; however, the quality of their blindfold play trumped that of Junior's. Deductively, one would imagine strong sighted play to correspond to strong blindfold play; however, that was not an overwhelming observation during the study. Perhaps this finding will catalyze further research endeavors.

Following blindfold play the participants were asked to hypothesize potential lines that formed a given position. The respondents evidenced two faculties of abstract cognition, namely visual-spatial ability and discreet pattern recognition. Three of the five respondents thoroughly enjoyed completing the supporting tasks of interview questions 11 and 12. Edward and James lost interest during this phase of the interview; however, Edward had formerly evidenced visual-spatial ability and pattern recognition during the blindfold simulation. One particular participant found the tasks named in interview questions 11 and 12 to be trivial, meaningless, and unnecessarily laborious. The researcher concluded that James's inability to complete the task did not suggest that he was entirely incapable of thinking abstractly but rather lacked interest in completing such an assignment. The task of responding with writing to the prompt was too similar to James's much hated seatwork. The principal researcher concludes that James's conceptualization of the potential chess lines differs from that of Carly, Jerelene, Edward, and Junior. Upon analyzing James's textual account, it is apparent that James is transitioning from Piaget's Concrete Operational Stage to the Formal Operations Stage.

Research Question 3: What are the cognitive processes that scholastic chess players use to anticipate potential outcomes?

The researcher concludes that scholastic chess players anticipate potential outcomes, consider hypothetical scenarios, recognize patterns and thematic ideas, implement tactics and book theory. Chess participants do so abstractly and with minimal detail. In continuation of the scholarly literature sourced by this particular study, the idea that abstract spatial-visual conceptualization of potential or hypothetical scenarios is done so with abstract representations of concrete events and tangible items such as chessmen abounds. Simply stated, conceptualizing hypothetical chess lines and sequences is cognitively and spatially taxing and in response, the participants have adapted to visualize squares, minor pieces, and so forth as abstract representations such as two-dimensional shapes, danger squares, and a smorgasbord of algebraic notation complete with 64 squares of real estate.

Two emergent themes surfaced from the textual accounts of the participants' cognitive process used to anticipate potential outcomes. First, the theme of anticipation versus pattern recognition was extracted from the data. All five participants evidenced some degree of pattern recognition as they analyzed the presented chess situation; however, the marginal difference between anticipation and that of pattern recognition is infinitesimally small. For example, James evidences baseline knowledge of modern chess theory as he instantly recognizes the Legal Trap from interview question 1. Upon recognizing the legal, he anticipates and/or recalls established theoretical lines in response to the recognized pattern. The researcher then compared James's response to the remaining four participants and the findings varied although the data pivoted about a fixed thematic point. Yes, anticipation and pattern recognition dissimilar, there is an intuitively obvious relationship that may be studied with subsequent research.

The theme of a shifting cognitive paradigm momentously emerges while analyzing and coding the dense data. Students were able to reason contrary to their own color initiative as they were asked to "conceptualize and accurately describe what it might have been like to be Khomyakov and down a pawn." Five of the five participants successfully completed the interview tasks associated with Research Question 3. Their conceptual processes are best summed with Carly's direct statement:

> I guess cause and effect, what-ifs, I can make moves here on the board and I suppose sometimes it's easier to visualize a forced move or an exchange sacrifice or any other chess tactic or strategy… I have to think about it [chess moves] in my head and when I think about it I, I just think of chess in terms of safety and danger, threats and immediate threats, and mortal threats. It's kind of like intellectual jousting and when I visualize this in my head, I don't really see the entire board. I don't see the actual chessmen… I know where they are at and I know where they can move to and I know where threats are coming from… I can't waste space trying to keep all of those photographs in my mind of the position. I have to simplify it… Kind of like devolving from 3D to 2D, just less detail I guess.

There is a relationship between the accumulated participatory scholastic chess hours and the content of the participants' cognitive description. The more a participant participates in chess club, the more that the participant is able to conceptualize hypothetical scenarios, anticipate potential ideas and problems, and generally think abstractly. Among the five respondents, Carly, Junior, Edward, and Jerelene evidenced future events with the use of imagine, see, visualize, and If/Then statements. Visualize was cited by all five participants and was the most used transcribed word associated with Research Question 3. From the review of

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literature and from the findings of this particular study, there emerges a distinction between visualize and view. Visualize is a construct of spatial-imagery that is associated with Piaget's Formal Operations Stage of abstract cognition.

Research Question 4: How do scholastic chess players describe the role of chess in their ability to anticipate dilemmas and generate solutions in other areas of life?

Perhaps the most pragmatic and idealistic extension of chess is the application of chess culture to one's life. Five of the five respondents described the role of chess in their ability to anticipate dilemmas and generate solutions in their life as markedly positive. Two superseding themes emerged from the initial coding of the textual data, namely visualizing actions and reactions and identifying possible solutions. The initial codes of visioning vs. visualizing, identifying the best possible move, sequencing, and analysis of lines served as the theoretical underpinnings of these two thematic codes. James and Carly find that chess has increased their abilities to anticipate future events and visualize precarious life scenarios and respond with solutions. For James, the role of chess has aided in his generating of life solutions. Carly found chess to be one large abstract strategy game in which anticipating dilemmas and generating solutions is essentially a biological, chemical, and atomic chess match of input and output. He retains information and uses information more efficiently since enrolling in the MHHS Chess Club. For Carly the role of chess in anticipating dilemmas and generating solutions is "Big, um I have changed my way of thinking since playing chess… I am making better choices." Jerelene implements chess thinking "all the time in real life." Jerelene uses abstract thinking in trivial tasks and in considerably more important objectives and goals. Junior uses abstract thinking consistently in his life, especially in academics. Junior uses this newfound abstract ability during online multiplayer gaming. James has recently transferred to the North Carolina School of the

Arts and on his application, cited how important the role of chess remains in his life. All five of the study's participants credit chess with increasing their mental capacity and ability to conceptualize life predicaments and challenges. The researcher concludes that chess affects the transition among Piaget's cognitive levels. Further, chess affects the phenomenon of abstract cognition and, in turn, positively and systematically affects the lives of five MHHS Scholastic Chess Club participants.

Recommendations for Practice

Data collected from the researcher's memos, the interviews, the observations, and the simulations offer suggestions for educational agencies and scholastic chess clubs. The following recommendations to increase opportunities for higher cognitive and abstract modalities are offered:

- Chess students should master algebraic notation to enhance the discussion of hypothetical or potential chess sequences and lines

- Upon acquiring a base knowledge of opening, middle, and endgame theory, chess participants should begin participating in blindfold chess play as a mode by which to increase their visual-spatial and abstract thinking abilities

- Annotation of both master and one's own games should be integral to the chess club experience

- Puzzles and/or tactics exercises should be a component of the chess club experience

- It is recommended that sponsors and/or teachers implement varying derivations of this study's interview questions as a means to measure progress toward increased abstract cognitive ability

Local education agencies and other institutions of learning should design and develop both behaviorally and developmentally appropriate chess curricula as a means to increase cognitive capacity and ability. Scholastic chess is relatively frugal in its operation where educators and chess enthusiasts alike should be supportive of educational policy reform reactive to the growing body of scholarly and cognitive chess research.

<p style="text-align:center;">*Recommendations for Further Research*</p>

It is the recommendation of the principal investigator to propose a call to curricular change with scholastic chess as the new research-based initiative to increase the frequency and depth of abstract cognitive phenomena. Upon recognizing the limits of the data analysis and literature review, the researcher presents the recommendations as suggestions for action based upon the study findings and the supporting literature. Subsequent research may include case study methodology that allows for a more holistic understanding of abstract cognition as a phenomenon among chess players (Bühren & Frank, 2010). This study's Piagetian conceptual framework has proven useful in the understanding of the cognitive processes among five MHHS Chess Club participants and should be used in future research. Further, this study's methodology as described in Chapter 3 holds promise and should be considered in subsequent and continuing research. Culminating from the research process, there are points of consideration for further scholarly research. Namely the interview, observation, and simulation tasks are relatively difficult tasks for novice and intermediate players to complete successfully and satisfactory. Future investigations and explorations should increase the pool of qualified applicants with each respondent conditioned with several semesters of club experience.

The principal investigator again reminds scholars and educators who are considering clinical qualitative approaches to studying the phenomenon of abstract cognition to recognize

that this methodology doesn't support the generalization of results to all children, adolescents, or teenage chess players but supports the study of a subject by considering the idiosyncratic details of the individual cases. Furthermore, experimenters and investigators alike are encouraged to choose a sample that represents a discrete demographic or subset of the larger population. Researchers should conduct preliminary interviews that test the merit of the questions in addition to the accuracy and precision of such interviews. Lastly, the data collected from the researcher's memos and the data collection protocols granted intimate insight into the phenomenon of abstract cognition among five participants. Future research should adhere to the advice of the cited authors and implement a qualitative case study approach as the principle means of systematically exploring and analyzing behavioral and developmental phenomena.

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APPENDICES

APPENDIX A

Institutional Review Board Approval Letter

ETSU

East Tennessee State University
Office for the Protection of Human Research Subjects • Box 70565 • Johnson City, Tennessee 37614-1707
Phone: (423) 439-6053 Fax: (423) 439-6060

IRB APPROVAL – Initial Expedited Review

September 18, 2014

Brent Laws
ELPA Dept., ETSU

Re: The Phenomenon of Abstract Cognition among Scholastic Chess Participants
IRB#: c0714.14s
ORSPA #: n/a

The following items were reviewed and approved by an expedited process:
- xform New Protocol Submission*; Parent Informed Consent Document (version 7/6/14, stamped approved 9/18/14); Parental Permission* (version 9/11/14, stamped approved 9/18/14); Child Assent (version 7/6/14, stamped approved 9/18/14); Protocol Questions; References; CV

The item(s) with an asterisk(*) above noted changes requested by the expedited reviewers.

On **September 18, 2014**, a final approval was granted for a period not to exceed 12 months and will expire on **September 17, 2015**. The expedited approval of the study *and* requested changes will be reported to the convened board on the next agenda.

Based on the **Review of the Child Advocate** the IRB determined that no greater than minimal risk to children is presented as it is largely observational and non-invasive in nature, involves the observation of routine tasks typically performed by participants in the context of their extracurricular chess activities in their program, and uses conventional research practices that are acceptable within the field. Permission of one parent is sufficient as the study presents minimal risk to the child participants and involves observational monitoring of their behavior in a voluntary extracurricular activity in which they are already engaged. The research is not subject to FDA regulations. Permission will be obtained appropriately and will be appropriately documented. If permission is to be obtained from a guardian, the guardian will be an individual who is authorized under applicable State or local law to consent on behalf of the child to general medical care. The IRB determined that assent is required for each child who is capable of providing assent based on age, maturity, and psychological state: Children participating in the chess program at the specified school location are grades 9-12 and are already a part of the program. Documentation of assent is required and must be documented by child signature on assent form.

Full
AAHRPP
Accreditation

Accredited Since December 2005

The following **enclosed stamped, approved Informed Consent Documents** have been stamped with the approval and expiration date and these documents must be copied and provided to each participant prior to participant enrollment:

- Parent Informed Consent Document (version 7/6/14, stamped approved 9/18/14)
- Parental Permission (version 9/11/14, stamped approved 9/18/14)
- Child Assent (version 7/6/14, stamped approved 9/18/14)

Federal regulations require that the original copy of the participant's consent be maintained in the principal investigator's files and that a copy is given to the subject at the time of consent.

Projects involving Mountain States Health Alliance must also be approved by MSHA following IRB approval prior to initiating the study.

Unanticipated Problems Involving Risks to Subjects or Others must be reported to the IRB (and VA R&D if applicable) within 10 working days.

Proposed changes in approved research cannot be initiated without IRB review and approval. The only exception to this rule is that a change can be made prior to IRB approval when necessary to eliminate apparent immediate hazards to the research subjects [21 CFR 56.108 (a)(4)]. In such a case, the IRB must be promptly informed of the change following its implementation (within 10 working days) on Form 109 (www.etsu.edu/irb). The IRB will review the change to determine that it is consistent with ensuring the subject's continued welfare.

Sincerely,
Stacey Williams, Chair
ETSU Campus IRB

Informed Consent

PRINCIPAL INVESTIGATOR: Brent C. Laws

TITLE OF PROJECT: The Phenomenon of Abstract Cognition among Scholastic Chess Participants

Consent Form for Participation in a Research Study

The Phenomenon of Abstract Cognition among Scholastic Chess Participants

You are invited to participate in a research study conducted by Mr. Brent C. Laws, EdS. This Informed Consent will explain about being a participant in a research study. It is important that you read this material carefully and then decide if you wish to be a volunteer.

Purpose of the Research

The purpose of this research is to explore the phenomenon (something that is observed or exists to happen) of abstract cognition (the ability to consider hypothetical scenarios and demands, to think ahead, anticipate potential outcomes, describe ideas, to visualize possible chess moves) among chess club participants at Mountain Heritage High School.

Your participation will involve the following: Solving chess puzzles, playing chess, playing blindfold chess, responding to interview questions, and vocalizing your thought process.

Duration

The expected duration of the study will be composed of ten to twenty contact hours over the course of three to four weeks.

Procedures

The procedures, which will involve you as a research subject, include:
Solving chess puzzles, vocalizing thoughts and ideas during over-the-board chess play, completing chess simulations over-the-board, engaging in blindfold chess play, interviewing (semi-structured) with Mr. Brent C. Laws. Note: There are no invasive techniques employed by this study. There are no specimens to be collected by this study. This study is not a double-blind test or experiment. There are no anticipated circumstances under which the participant's participation will be terminated by the investigator without regard to the participant's consent.

Alternative Procedures/Treatments

There are no alternative procedures/treatments available to you if you elect not to participate in this study.

Ver. 07/06/14

Page 1 of **DOCUMENT VERSION EXPIRES** Subject Initials _____

PRINCIPAL INVESTIGATOR: Breat C. Laws
TITLE OF PROJECT: The Phenomenon of Abstract Cognition among Scholastic Chess Participants

Possible Risks/Discomforts

There are no known risks or discomforts associated with this research.

Potential benefits

There are no known potential benefits to you that would result from your participation in this research. You will receive no direct benefit from your participation in this research study.

Financial Costs

There are no financial costs to you that would result from your participation in this research.

Compensation in the Form of Payments to Research Participants

There is no compensation for your participation in this research.

Voluntary Participation

Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study. In short, you may refuse to participate. You can quit at any time. You may quit by calling Mr. Laws, whose phone number is 828.284.3318. You will be told immediately if any of the results of the study should reasonably be expected to make you change your mind about staying in the study.

Contact Information

If you have any questions or concerns, problems or research-related medical problems at any time, then please contact Mr. Brent C. Laws at Mountain Heritage High School at 828.682.6103 or alternatively at 828.284.3318. You may call the Chairman of the Institutional Review Board at 423.439.6054 for any questions you may have about your rights as a research subject. If you have any questions or concerns about the research and want to talk to someone independent of the research team or you can't reach the study staff, you may call an IRB Coordinator at 423.439.6055 or 423.439.6002.

Ver. 07/06/14

PRINCIPAL INVESTIGATOR: Brent C. Laws

TITLE OF PROJECT: The Phenomenon of Abstract Cognition among Scholastic Chess Participants

Confidentiality

Every attempt will be made to see that your study results are kept confidential. A copy of the records from this study will be stored in East Tennessee State University Department of Educational Leadership and Policy Analysis department for at least 5 years after the end of this research. The results of this study may be published and/or presented at meetings without naming you as a subject. Although your rights and privacy will be maintained, the Secretary of the Department of Health and Human Services, the ETSU IRB, and personnel particular to this research (Mr. Brent C. Laws and Dr. Bill Flora) have access to the study records. Your records will be kept completely confidential according to current legal requirements. They will not be revealed unless required by law, or as noted above.

Consent

By signing below, I confirm that I have read or had this document read to me. I will be given a signed copy of this informed consent document. I have been given the opportunity to ask questions and to discuss my participation with the investigator. I freely and voluntarily choose to participate in this study.

Participant's signature_____ Date:_____

Participant's printed name _____ Date:_____

Signature of Researcher _____ Date:_____

Signature of Witness (if applicable) _____ Date:_____

A copy of this consent form will be given to you.

Ver. 07/06/14   Page 3 of 3   Subject Initials _____

APPENDIX C

Parental Permission

PRINCIPAL INVESTIGATOR: Brent C. Laws

TITLE OF PROJECT: The Phenomenon of Abstract Cognition among Scholastic Chess Participants

Parental Permission Form for Child Participation in a Research Study

The Phenomenon of Abstract Cognition among Scholastic Chess Participants

Your child is invited to participate in a research study conducted by Mr. Brent C. Laws, EdS. This Informed Consent will explain about your child's participation in a research study. It is important that this material is read carefully and before deciding if you wish to allow your child to be a volunteer.

Purpose of the Research

The purpose of this research is to explore the phenomenon (something that is observed or exists to happen) of abstract cognition (the ability to consider hypothetical scenarios and demands, to think ahead, anticipate potential outcomes, describe ideas, to visualize possible chess moves) among chess club participants at Mountain Heritage High School.

Your child's participation will involve the following: Solving chess puzzles, playing chess, playing blindfold chess, responding to interview questions, and vocalizing your thought process.

Duration

The expected duration of the study will be composed of ten to twenty contact hours over the course of three to four weeks.

Procedures

The procedures, which will involve your child as a research subject, include: Solving chess puzzles, vocalizing thoughts and ideas during over-the-board chess play, completing chess simulations over-the-board, engaging in blindfold chess play, interviewing (semi-structured) with Mr. Brent C. Laws. Note: There are no invasive techniques employed by this study. There are no specimens to be collected by this study, This study is not a double-blind test or experiment. There are no anticipated circumstances under which your child's participation will be terminated by the investigator without regard to your parental permission and your child's assent.

Alternative Procedures/Treatments

Ver. 09/11/14

APPROVED
By the ETSU IRB

SEP 1 8 2014

By
Chair IRB Coordinator

Page 1 of 3

DOCUMENT VERSION EXPIRES

SEP 1 7 2015

ETSU IRB

Parent's Initials_____

PRINCIPAL INVESTIGATOR: Brent C. Laws

TITLE OF PROJECT: The Phenomenon of Abstract Cognition among Scholastic Chess Participants

There are no alternative procedures/treatments available to your child if you elect not to allow your child to participate in this study.

Possible Risks/Discomforts

There are no known risks or discomforts associated with this research.

Potential benefits

There are no known potential benefits to your child that would result from your child's participation in this research. Your child will receive no direct benefit from his/her participation in this research study.

Financial Costs

There are no financial costs to you or your child that would result from your child's participation in this research.

Compensation in the Form of Payments to Research Participants

There is no compensation for your child's participation in this research.

Voluntary Participation

Your child's participation in this research study is voluntary. Your child may choose not to participate and your child may withdraw his/her consent to participate at any time. Your child will not be penalized in any way should s/he decide not to participate or to withdraw from this study. In short, your child may refuse to participate. Your child can quit at any time. Your child may quit by calling Mr. Laws, whose phone number is 828.284.3318. You and your child will be told immediately if any of the results of the study should reasonably be expected to make your child change his/her mind about staying in the study.

Contact Information

If there are any questions or concerns, problems or research-related medical problems at any time, then please contact Mr. Brent C. Laws at Mountain Heritage High School at 828.682.6103 or alternatively at 828.284.3318. You may phone the Chairman of the Institutional Review Board at 423.439.6054 for any questions you may have about your rights as a research subject. If you have any questions or concerns about the research and want to

Ver. 09/11/14

APPROVED
By the ETSU IRB

SEP 1 8 2014

By _aa_
Chair IRB Coordinator

Page 2 of 3

DOCUMENT VERSION EXPIRES

SEP 1 7 2015

ETSU IRB

Parent's Initials _____

talk to someone independent of the research team or you can't reach the study staff, you may call an IRB Coordinator at 423.439.6055 or 423.439.6002.

Confidentiality

Every attempt will be made to see that your child's study results are kept confidential. A copy of the records from this study will be stored in East Tennessee State University Department of Educational Leadership and Policy Analysis building for at least 5 years after the end of this research. The results of this study may be published and/or presented at meetings without naming your child as a subject. Although your child's rights and privacy will be maintained, the Secretary of the Department of Health and Human Services, the ETSU IRB, and personnel particular to this research (Mr. Brent C. Laws and Dr. Bill Flora) have access to the study records. Your child's records will be kept completely confidential according to current legal requirements. They will not be revealed unless required by law, or as noted above.

Consent

By signing below, I confirm that I have read or had this document read to me. I will be given a signed copy of this informed consent document. I have been given the opportunity to ask questions and to discuss my child's participation with the investigator. By signing below, you confirm that you allow your child to participate in this research study

Parent's signature _____   Date:_____

Parent's printed name _____   Date:_____

Printed Child's name _____   Date:_____

Signature of Investigator _____   Date:_____

Signature of Witness (if applicable) _____   Date:_____

A copy of this consent form will be given to you.

Ver. 09/11/14   **APPROVED**   Page 3 of 3   Parent's Initials _____
By the ETSU IRB
                                   DOCUMENT VERSION EXPIRES
SEP 1 8 2014
By_____   SEP 17 2015
Chair/IRB Coordinator
                                   ETSU IRB

APPENDIX D

Student Assent

Assent Form for Participation in a Research Study

The Phenomenon of Abstract Cognition among Scholastic Chess Participants

You are invited to participate in a research study conducted by Mr. Brent C. Laws, EdS. Your parents have already given you permission to participate in this study. This minor assent document will explain about being a participant in a research study. It is important that you read this material carefully and then decide if you wish to be a volunteer.

Purpose of the Research

The purpose of this research is to explore the phenomenon (something that is observed or exists to happen) of abstract cognition (the ability to consider hypothetical scenarios and demands, to think ahead, anticipate potential outcomes, describe ideas, to visualize possible chess moves) among chess club participants at Mountain Heritage High School.

Your participation will involve the following: Solving chess puzzles, playing chess, playing blindfold chess, responding to interview questions, and vocalizing your thought process.

Duration

The expected duration of the study will be composed of ten to twenty contact hours over the course of three to four weeks.

Procedures

The procedures, which will involve you as a research subject, include: Solving chess puzzles, vocalizing thoughts and ideas during over-the-board chess play, completing chess simulations over-the-board, engaging in blindfold chess play, interviewing (semi-structured) with Mr. Brent C. Laws. Note: There are no invasive techniques employed by this study. There are no specimens to be collected by this study, This study is not a double-blind test or experiment. There are no anticipated circumstances under which the participant's participation will be terminated by the investigator without regard to the participant's consent.

Alternative Procedures/Treatments

There are no alternative procedures/treatments available to you if you elect not to participate in this study.

Ver. 07/06/14   APPROVED   Page 1 of 3   DOCUMENT VERSION EXPIRES   Subject Initials _____
By the ETSU IRB
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Chair IRB Coordinator

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PRINCIPAL INVESTIGATOR: Brent C. Laws
TITLE OF PROJECT: The Phenomenon of Abstract Cognition among Scholastic Chess Participants

Possible Risks/Discomforts

There are no known risks or discomforts associated with this research.

Potential benefits

There are no known potential benefits to you that would result from your participation in this research. You will receive no direct benefit from your participation in this research study.

Financial Costs

There are no financial costs to you that would result from your participation in this research.

Compensation in the Form of Payments to Research Participants

There is no compensation for your participation in this research.

Voluntary Participation

Your participation in this research study is voluntary. You may choose not to participate and you may withdraw your consent to participate at any time. You will not be penalized in any way should you decide not to participate or to withdraw from this study. In short, you may refuse to participate. You can quit at any time. You may quit by calling Mr. Laws, whose phone number is 828.284.3318. You will be told immediately if any of the results of the study should reasonably be expected to make you change your mind about staying in the study.

Contact Information

If you have any questions or concerns, problems or research-related medical problems at any time, then please contact Mr. Brent C. Laws at Mountain Heritage High School at 828.682.6103 or alternatively at 828.284.3318. You may call the Chairman of the Institutional Review Board at 423.439.6054 for any questions you may have about your rights as a research subject. If you have any questions or concerns about the research and want to talk to someone independent of the research team or you can't reach the study staff, you may call an IRB Coordinator at 423.439.6055 or 423.439.6002.

PRINCIPAL INVESTIGATOR: Brent C. Laws

TITLE OF PROJECT: The Phenomenon of Abstract Cognition among Scholastic Chess Participants

Confidentiality

Every attempt will be made to see that your study results are kept confidential. A copy of the records from this study will be stored in East Tennessee State University Department of Educational Leadership and Policy Analysis department for at least 5 years after the end of this research. The results of this study may be published and/or presented at meetings without naming you as a subject. Although your rights and privacy will be maintained, the Secretary of the Department of Health and Human Services, the ETSU IRB, and personnel particular to this research (Mr. Brent C. Laws and Dr. Bill Flora) have access to the study records. Your records will be kept completely confidential according to current legal requirements. They will not be revealed unless required by law, or as noted above.

Consent

By signing below, I confirm that I have read or had this document read to me. I will be given a signed copy of this minor assent document. I have been given the opportunity to ask questions and to discuss my participation with the investigator. I freely and voluntarily choose to participate in this study.

Minor Participant's signature _____   Date: _____

Minor Participant's printed name _____   Date: _____

Signature of Researcher _____   Date: _____

Signature of Witness (if applicable) _____   Date: _____

A copy of this consent form will be given to you.

VITA

BRENT CARLIE JAMES LAWS

Education:	East Tennessee State University, Johnson City, TN Ed.D. Educational Leadership 2014
	Lincoln Memorial University, Harrogate, TN Ed.S. Curriculum and Instruction 2012
	Lincoln Memorial University, Harrogate, TN M.Ed. Educational Administration and Supervision 2010
	University of North Carolina Asheville, Asheville, NC Post-Baccalaureate Teacher Licensure Math/Science 2009
	University of North Carolina Asheville, Asheville, NC B.S. Physics 2008
Professional Experience:	9-12 Mathematics Teacher, 2010 - Present Yancey County Schools, NC
	Head Varsity Tennis Coach, 2010 – Present Yancey County Schools, NC
	Chess Club Sponsor, 2010 – Present Yancey County Schools, NC
	Head Tennis Coach, 2009 Asheville City Schools, NC
	6-9 Science Teacher, 2008-2009 Madison County Schools, NC
North Carolina Licensure:	Curriculum and Instructional Specialist K-12 Principal 9-12 Physics 9-12 Comprehensive Science 9-12 Mathematics 6-9 Science 6-9 Mathematics