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The Role of Video Game Play, Gender Roles, and Career Decision Self-Efficacy in Development of STEM Career Interests & Motivation

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THE ROLE OF VIDEO GAME PLAY, GENDER ROLES, AND CAREER DECISION SELF-EFFICACY IN DEVELOPMENT OF STEM CAREER INTERESTS & MOTIVATION

by

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ABSTRACT

The gender wage gap, disadvantaging working women, continues to grow despite progress toward women's rights and occupational equity. With the world economy prioritizing growth in technological industries, the underrepresentation of women in science, technology, engineering, and mathematics (STEM) fields perpetuates systemic gender inequity. Further, given traditional social gender roles, women and girls may be less likely than boys and men to pursue STEM careers. Though specialized programs seek to grow the number of girls and young women engaged in STEM-related education and prepare them for the growing demand for STEM laborers, these programs are regional, seasonal, and not widely available (Girls Who Code, 2019). Therefore, other cost-effective interventions are needed to help facilitate and maintain interest among girls and women in STEM-related subject matter and careers. As video games are associated with development of STEM skills (Bonner & Dorneich, 2016; Blickenstaff, 2005; Feng, Spence & Pratt, 2007; Giammarco et al., 2014), they may also serve as a mechanism by which to increase girls' and women's interest in STEM. The purpose of this study is to assess the relationships between video gaming, gender roles, career-decision self-efficacy, and STEM career interest and motivation. Specifically, video gaming as a potential moderator of the relationship between gender roles and STEM career interest and motivation will be explored.

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For Wade, the best zombie hunting partner anyone could ever ask for.

TABLE OF CONTENTS

ABTRACT 3
TABLE OF CONTENTS 6
Chapter One 10
Statement of the Problem 10
Justification for the Present Study 10
Review of the Literature 10
Social Cognitive Career Theory and Career Aspiration 10
Bloom's Taxonomy 12
Gender & Development of Career Interest 14
Gender Schemas 15
Parental influences on gender schema construction 21
Modeling gender roles 22
Peer influence on gender schema construction 23
Personal Interests and STEM Career 25
STEM Careers Outlook 26
Women in STEM Careers 27
History of Vocational Gender Inequality 28
Legislation for Equality 30
Sexism in the Work Place 33
Mothers in the Work Place 35
Gender Wage Gap 36
Gender Inequality in STEM Careers 38
Development of STEM Career Interest Among Girls and Women 39
Increasing Opportunity for Girls and Women in STEM 42
Education and STEM 43
Gender Similarities in STEM-Related Skills 43
Video Gaming 46

History of Video Gaming 46
Current Trends in Video Gaming 48
Virtual Sexism and Objectification Theory 48
Aggression in Video Game Play 51
Participation in Social Video Game Play 53
Importance of Gender Equity Among Gamers 55
Video Gaming & STEM 56
The Present Study 56
Hypotheses 57
Chapter Two: Method 57
Participants 57
Measures 58
Gaming Frequency 58
STEM Career Motivation 58
STEM Career Interest 59
Gender Roles 59
Career Decision Self-Efficacy 60
Data Analysis 60
Chapter Three: Results 60
Data Cleaning and Preparation 60
Assessing for Parametric Assumptions 61
Correlations 62
Comparison of Means Between Groups 63
Moderation 64
Chapter Four: Discussion 65
Integration with Previous Research 67
Implications for Future Research 68
Implications for Practice 69

Limitations 70
Conclusion 70
References 72
APPENDIX A 97
Demographic Questionnaire 98
APPDENDIX B 103
Science Motivation Questionnaire II 104
APPENDIX C 107
Career Interest Questionnaire 108
APPENDIX D 110
Social Roles Questionnaire 111
APPENDIX E 113
Career Decision Self-Efficacy Scale – Short Form 114
APPENDIX G 118
Tables 119

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CHAPTER ONE: INTRODUCTION

The gender wage gap, disadvantaging working women, continues to grow despite progress toward women's rights and occupational equity. With the world economy prioritizing growth in technological industries, the underrepresentation of women in science, technology, engineering, and mathematics (STEM) fields perpetuates systemic gender inequity. Though programs including Girls Who Can Code (2019) and the Girls Scouts STEM Center of Excellence camp (2019) seek to grow the number of girls and young women engaged in STEM-related education and prepare them for the growing demand for STEM laborers, these programs are regional, seasonal, and not widely available. Therefore, other cost-effective interventions are needed to help facilitate and maintain interest among girls and women in STEM-related subject matter and careers. As video games are associated with development of STEM skills (Bonner & Dorneich, 2016; Blickenstaff, 2005; Feng, et al., 2007; Giammarco et al., 2014), they may serve as a mechanism by which to increase girls' and women's interest in STEM.

Social Cognitive Career Theory and Career Aspiration

Social cognitive career theory (SCCT) is an extension of Albert Bandura's social cognitive theory (SCT; Bandura, 1977). SCCT addresses how initial interests in a career path are developed and the preparatory choices an individual makes to ready themselves for that career (Lent, Brown, & Hackett, 2006). Three major variables comprise the foundation of the theory: (1) self-efficacy, (2) expectations of results, and (3) established goals of the individual (Lent, Brown, & Hackett, 2002).

Self-efficacy refers to one's belief about their ability to produce desirable effects in the face of novel challenges (Bandura, 1994). In terms of career aspirations, when someone attempts something novel, their success or failure influences how they perceive their skillset related to the task (Bandura, 1994). For the development of self-efficacy, resiliency, or the ability to recover

from failure, must develop through persistence when faced with failure, in turn, providing opportunity for success to be achieved (Bandura, 1994; Haidt, 2006). Once an individual finds a pathway for success in the novel situation, the situation becomes more easily navigable as confidence in one's abilities related to the situation, and ability to prevail when faced with a novel situation, develop (Bandura, 1994; Haidt, 2006).

Expectations of results refers to the beliefs one holds about the consequences of a situation due to their performance of a specific set of behaviors (Lent et al., 2002). In other words, an individual concludes how they believe an event will turn out based on the associated types of behaviors they utilized. For example, studying for several hours per night two weeks prior to the test might lead an individual to expect to do well on a test. Conversely, preparing for a major interview the night before the interview is scheduled to occur might lead someone to believe that they will perform poorly during the interview.

The third component of SCCT is the *establishment of personal goals.* It is important for an individual to exercise their principles and have control over their own educational and occupational pursuits (Lent, 2013). Through setting goals, an individual can channel their efforts to shape their behaviors and progress towards their goals which will, in turn, shape future behaviors (Lent, 2013).

SCCT states that an individual's career goals will be heavily affected by their level of self-efficacy in areas related to those goals. Self-efficacy is also influence by the *outcome expectations*, or how successful the individual believes they will be in their pursuit of those career goals. (Lent, 2013). An individual is likely to pursue goals along a career path in an area with which they have some level of familiarity, some level of success, capacity to imagine tangible goals within that career, and demonstrated progress towards establishing themselves in

that career field (Lent et al., 2002). For example, an individual who wishes to pursue a career as a musician would be best motivated to do so if they had some exposure to creating music, some success practicing their music, such as having a large ovation at a musical recital, realistic goals, and tangible progress towards those goals, like learning a new song and measuring how well they are progressing towards playing the song by the number of notes missed.

Combining personal career goals with areas wherein one is likely to achieve success leads to higher rates of continued success as compared to goals that are established outside of one's area of perceived competence (Bandura, 1977; Lent et al., 2002). In other words, doing what one enjoys and in which they excel leads to the establishment of more holistic goals and success in reaching those goals. The experience of early success leads to a bolstered sense of self-efficacy and resilience, after which the individual applies more of themselves in order to achieve mastery within that area (Bandura, 1977; Lent et al., 2002). For children and young adults, early academic success often leads to established interests in areas in which the student was successful (Rocchino et al., 2017). For example, a child who received grades of "A" or better in mathematics will likely believe that they have an ability to learn and understand mathematics quickly. In believing that they have a skillset that will allow them to achieve in the study of mathematics, the child is more likely to establish personal and career goals aligned with the mastery of mathematical principles and more readily apply themselves than another student who has consistently received a grade of "D" or below in mathematics.

Bloom's Taxonomy

The process of learning through exploration of novel ideas is best understood utilizing via Bloom's taxonomy of learning (Anderson & Krathwohl, 2001). Bloom's taxonomy is a hierarchical stage model of learning the consists of six stages: Remember, Understand, Apply,

Analyze, Evaluate, and Create (Anderson & Krathwohl, 2001). Through these stages, children establish strategies to approach and solve novel problems.

At the lowest order of thinking skills, *remembering* involves the ability to recognize and recall previously encountered information (Anderson & Krathwohl, 2001). *Understanding* builds upon the ability to remember by utilizing the remembered information and interpreting and categorizing the information. For example, a child may remember encountering a spider, however once they are able to understand that a spider is dangerous, they can categorize the spider as being something they may wish to avoid. Bloom's third stage, *application*, includes the executing of behaviors and thoughts that allow an individual to act on the remembered and understood information. For the child who recognizes the dangerous spider, they can then apply their knowledge and alert an adult (Anderson & Krathwohl, 2001).

Bloom's last three stages are the most cognitively advanced. The fourth stage, *analyzing*, is the ability to differentiate and deconstruct information into the facets that comprise the whole. *Evaluation*, the fifth stage, includes being able to critique and test information while *creation*, the sixth and final stage, involves developing the ability to hypothesize, plan and produce something novel based on the information.

As children work their way through the stages of Bloom's taxonomy, they begin to formulate strategies for navigating novel situations. Children can then apply the strategies that they have developed to determine which approaches are successful in a given situation. For a child learning about puppies, they may learn that running at a puppy will have a different consequence than walking calmly towards the puppy and can then implement strategies for approaching the dog that fits their desired goals. In relation to SCCT, as children begin to implement learned strategies, applying them to novel subject matter, and via social experiences

and exposure to more of the world, strategies begin to inform at what they excel. Bloom's taxonomy is a framework by which children optimize self-efficacy when faced with novel situations (Anderson & Krathwohl, 2001; Bandura, 1994).

Gender & Development of Career Interest

A distinction must first be established between "gender" and "sex". *Sex* refers to the genetic makeup and physiological presentation of an individual of both primary (e.g. vagina, penis, ovaries, testes, etc.) and secondary (e.g. breasts, voice changes, etc.) physical features developed in utero and over the lifetime (Hyde & DeLamater, 2017; Phillips, 2005). *Gender* refers to an organized set of rules, norms, and social expectations traditionally assigned to individuals based on the primary sex organs with which the individual was born (Phillips, 2005; World Health Organization, 2019); however, *gender identity* refers to one's sense of themselves as a gendered being and may not correspond with sexual anatomy or sex assigned at birth (Nadal, 2018). However, for the purposes of this manuscript, and given the binary nature of gender in extant career development literature, only cisgender boys/men and girls/women will be discussed. Further, sex and gender, though distinct constructs, are often used interchangeably in the reviewed scholarship, particularly less recent works. The present study will retain the original authors' terms with the understanding that sex is often inaccurately conflated with gender and this study is most interested in the role of gender.

Gender identity is not developed in isolation; rather, it is a conglomerate of social influences as well as personal desires (Benziman & Marodes, 1997). No solitary facet of identity is an adequate determiner of whether a person identifies as "masculine" or "feminine" as the intended meaning of "masculinity" and "femininity" vacillates depending on the construct that is being measured (Benziman & Marodes, 1997; Biller, 1974). Rather, *gender expression* refers to

the physical manifestation of one's gender identity through choice in clothing, hair style, body shape and even career choice (Trans Student Educational Resource, 2011).

Tyson (1982) identified three distinct events in the construction of one's gender identity. Initially, one develops a conscious and unconscious desire to belong with a particular gender group, labeled the "core gender identity", after which behaviors that align with the desired gender group are established, constituting a "gender role". Finally, one establishes a love object, or the "sexual partner orientation". Tyson (1982) argued that these stages do not occur discretely, nor are they concrete as change is expected to occur frequently throughout one's life. However, these stages provide a base model from which to operate when considering the development of gender identity.

Gender schemas. Gender Schema Theory (GST) posits that development of gender role is the result of a child's creation of a schema, a broad pattern of what is normal in a situation, based on sex assigned at birth and input from external sources about what behaviors are expected given their sex assigned at birth (Bem, 1981; Martin & Halverson, 1981; Coyle & Liben, 2016). Children utilize comparison of themselves to prototypically gendered peers and to gendered situations to establish perceived adequacy in their gender role and alignment along the socially expected developmental path (Bem, 1981; Coyle & Liben, 2016).

GST provides additional insight as to children's interaction with peers, adults, and gender-accepted items and toys (Coyle & Liben, 2016; Martin et al., 2005). Liben and Bigler (2002) suggested a dual-pathway model in the construction of gendered behavior. An *attitudinal* pathway is structured much like the main principal of GST in which a child's own beliefs of what is appropriate and acceptable "feminine" and "masculine" behavior is held. The second *personal* pathway holds the child's personal interests, thoughts, and modifications with regard to

gender attitudes (Liben & Bigler, 2002). Thus, in the dual-pathway model, children's knowledge of expectations and personal experience of gender inform behavior.

Born from the dual-pathway approach is the gender salience filter (GSF) which refers to how one understands the role of gender within their world (Liben & Bigler, 2002). GSF informs the manner by which one behaves based upon expected gender roles as well as embodiment of those gender roles. Children with strong gender salience filters are better able to identify connections between their interactions with the world and how those interactions are interpreted by others in relation to their expected gender identity (Liben & Bigler, 2002).

The implementation of GSF, while unquestionably influenced by external social pressures, also relies on the relationship between style of play and the individual. For example, a young girl who is interested in playing with toy planes will be more likely to engage in egalitarian play and less likely to adhere to gendered ideology regarding the toy (i.e. "Planes are for boys"; Liben & Bigler, 2002). If gender schema were less rigidly defined by traditional social gender roles, a more egalitarian style of play might be established earlier in life. As many careers are considered stereotypically *masculine* or *feminine* (Liben et al., 2001), constructing an early egalitarian gender schema may directly contribute to career interests and decisions.

Therefore, gender represents another important variable influencing the development of career interests and goals in childhood and adolescence. For many, career decisions begin to take shape prior to birth, with their assigned biological sex serving as a harbinger of their available options before the child can develop interests or mastery (Brown & Lent, 2013). Gottfredson (1981; 2004) advanced her theory of circumscription and compromise to provide insight to the ways that gender identification influences occupational development and opportunity. Gottfredson stated that vocational assessment begins with the act of *circumscription*, or

elimination of occupations that conflict with an individual's sense of self (Gottfredson, 2005). This happens via progression through four developmental phases: Stage 1: Orientation to Size and Power (ages 3 to 5), Stage 2: Orientation to Gender Roles (ages 6 to 8), Stage 3: Orientation to Social Valuation, and Stage 4: Orientation to Internal Unique Self (ages 9 to 13; Gottfredson, 2005). As children mature and progress toward adulthood, the act of *compromise*, or the selection of one of the remaining occupational alternatives, occurs as adolescents begin to consider what is reasonably attainable for their skills (Gottfredson, 2005; Swanson & Fouad, 2010). Notably, these stages are based on cisgender male and female children/adolescents.

In the first stage, children begin to classify people in terms of being big or small, strong or weak. This stage also culminates with children beginning to understand that work is something in which adults engage. Subsequently, children no longer report wanting to be animals (horses), fantasy characters (princesses), or inanimate objects (volcano) when they reach adulthood (Brott, 1993; Gottfredson, 2005).

During the second stage, Orientation to Sex Roles, children begin to identify features of adult work salient to specific professions such as a uniform (athlete's jersey, military member's uniform, doctor's scrubs), identifiable equipment (a firetruck, a briefcase, a firearm), or other high-visibility items that would draw a child's attention (Gottfredson, 2005). At this stage, children are dichotomous thinkers and, as such, begin to categorize vocations by sex, typically male and female as associated with sex assigned at birth. Children begin to eliminate occupations that are not consistent with their identified sex, as they begin to perceive their own gender/sex as superior to others (Gottfredson, 2005).

The third stage, Orientation to Social Valuation, includes a child's ability to think about work in an abstract manner, understanding that different occupations can include similar actions

and behaviors (Gottfredson, 2005). For example, children may be aware that both lawyers and receptionists sit at a desk but can discern that the two roles are different, as are the tasks associated with each. Children are also able to determine social class and occupational prestige of their peers and peers' families through their appearance, speech, and possessions and, informed by such information, assign levels of prestige to a variety of occupations. Further, gender-based occupational affiliations begin to crystallize as children progress in this third stage. Stage three is a paramount stage as, by its conclusion around the age of 13, children omit large categories of occupation that do not align with their personal gender identification and desired level of occupational prestige, or appear too difficult (Gottfredson, 2005).

An individual's *social space*, the external social influences comprised of an individual's genetic makeup, gender identification, family structure, socioeconomic status, religion, and other capacities that construct an individual's socio-cultural background (Gottfredson, 2005; Hesketh et al., 1989; Swanson & Fouad, 2010), is prominent during all stages of the circumscription process but becomes more salient during the third stage. Social space informs how an individual understands the manner by which the world views them in the context of their interactions with the world. Pertinent to career decisions for children, the availability of opportunities to pursue specific professions is determined, in part, by social space (Gottfredson, 2005; 1981). For example, a White male adolescent from an affluent family may aspire to be President of the United States, and their interactions with the world may facilitate this opportunity as they mature. A Hispanic female adolescent from a family living in poverty may, too, aspire to be President of the United States, however her interactions with the world would likely yield significantly less support of her pursuit, effectively reducing the likelihood that she becomes President.

In the fourth and final stage, Orientation to Internal Unique Self, children begin to think about occupations and career in a more conscious and intentional manner. In this stage, children begin to balance their understanding of professions to which they have been exposed with consideration for which professions they would like to pursue (Gottfredson, 2005). As children mature, incorporation of other external values, such as starting a family, begin to have more influence on potential career paths. Children also begin to distinguish between *ideal aspirations*, occupations in which an individual would like to see themselves, and *realistic aspirations*, occupations in which an individual can actually see themselves when accounting for time, competition, training, education, work/life balance and non-vocational aspirations (Gottfredson, 2005).

During the act of circumscription, an occupation's gender type is the preeminent dimension that decides whether a child will consider an occupation as a viable option; occupations that have a perceived gender type that does not coincide with how the individual identifies regarding gender are jettisoned (Gottfredson, 2005). In the hierarchy of job selection, gender type synchronization is prioritized over any other aspect of occupational consideration, including prestige and pay rate (Gottfredson, 2005).

Compromise, the process by which individuals begin to eliminate ideal occupations for occupations that might be less compatible but more attainable, occurs during this final stage (Gottfredson, 2005; Swanson & Fouad, 2010). As individuals mature and begin to eliminate ideal aspirations perceived as unattainable and begin to concentrate their efforts towards realistic aspirations, they form a *zone of acceptable alternatives* (Capuzzi & Stauffer, 2012). Once additional information is gathered about occupations within the zone, further eliminations are

made via circumscription to narrow the possibilities to those options that appear most attainable (Capuzzi & Stauffer, 2012; Gottfredson, 2005; Swanson & Fouad, 2010).

A primary contributor to the act of compromise is an individual's lack of exhaustive knowledge regarding available career options (Gottfredson, 2005). Individuals tend to primarily seek information that is relevant to the handful of ideal occupations that they desire, creating a void of knowledge regarding other occupational possibilities (Gottfredson, 2005; Swanson & Fouad, 2010). Focus on a limited selection of occupations coerces an individual to decide on less desirable occupations that are "good enough" or "not too bad" as idealized occupations are eliminated due to the disbelief in their attainability (Swanson & Fouad, 2010). The act of dedicating oneself to an occupation with incomplete knowledge highlights the difference between a *career choice*, a voluntary selection of an occupation that is an optimal fit between the realms of an individual's unique self and vocation and maximizes the requirements for one's standards regarding career, and *career compromise*, the acceptance of a path that meets minimum requirements for what is an acceptable occupation.

Much like during the process of circumscription, one's social space plays a prominent role in the hierarchy of the compromise process (Gottfredson, 2005). An individual's interest in an occupation is typically the first value sacrificed followed by prestige. The last value to be sacrificed is the gender-type relationship between the individual and the occupation (Gottfredson, 2005). In other words, during the compromise process, a young woman would be more likely to dedicate herself to an occupation with less prestige and in which she has little interest than to consider pursuing an occupation that is perceived as masculine or male-oriented due to the conflict in gender-type.

Parental influences on gender schema construction. Parents set precedent for the installation and integration of early systems of self-acceptance and gender schema alignment through their support and reinforcement of behaviors that are aligned with traditional gender roles (Borgman, 2009). For example, girls who engage in physical contact sports may be encouraged to continue to do so by their parents at an early age, but may receive less support as they mature since physical domination is not aligned with traditional gender roles for girls/women.

As additional identities are factored into an individual's social composite, parental reinforcement of social messages changes the direction of gendered socialization. One study found that Black girls were provided with consistent messages from their mothers to prioritize emotional strength and to be self-reliant in both their decision-making and ability to fight for personal freedoms (Oshin & Milan, 2019). Messages for young Black girls may more closely resemble social norms for young boys (Arens & Watermann, 2017). By contrast, young Latina girls are more likely to receive messages of *marianismo*, a cultural ideology which emphasizes a focus on the family over the self, a submissive temperament, chastity, and being a dependable individual for other members of the overall family system (Castillo et al., 2010; Upchurch et al., 2001). Thus, gendered messages communicated by parents differ significantly across racial/ethnic groups.

Perales and colleagues (2018) made a telling remark about the ways in which parenting behaviors are influenced by the biological sex of their child:

> Men and women who become parents of a girl should benefit more from a gender-egalitarian society in which their daughters are treated fairly and permitted to enjoy the full range of opportunities. For example, it would be in the best interest of parents of daughters

> to live in a society in which intimate partner violence against women is not tolerated, or in which there are no gender pay gaps. For parents of sons, however, there may be fewer perceived advantages associated with societal gender egalitarianism. The perpetuation of the current status quo, in which girls and women remain disadvantaged in a range of life domains, may in fact result in a comparative advantage for their male sons (p. 254).

Fundamental change towards more egalitarian opportunity begins at home, as their immediate family system is where the foundational understanding of social constructs originates (Bandura & Walters, 1977).

Modeling gender roles. The manner by which a child learns to socialize directly influences the development of their gender schema. Housework is an example of how gender schema influences day-to-day conceptualizations of work "for men" versus work "for women". Yavorsky and colleagues (2015) utilized time diaries from 364 new parents in heterosexual couples (182 men, 182 women) between the third trimester of pregnancy and the ninth month after the child's birth to track the amount of time capital the parents spent completing unpaid labor (i.e. various types of housework and child care). Couples reported equal time spent in the division of unpaid household labor prior to birth of their child (14.51 hours per week), however, after the child's birth, women experienced a weekly increase of 4.5 hours of unpaid labor, whereas men reported an average increase of 40 minutes per day spent completing household tasks after the child's birth (Yavorsky et al., 2015).

In general, women spend more time completing unpaid labor in heterosexual relationships (Endendijk et al., 2017), especially when the couple has children. The Bureau of Labor Statistics (BLS) via responses from over 200,000 individuals over the age of 15 surveyed between 2003 to 2018 for the American Time Use Survey (ATUS) database.

According to the ATUS (2018) almost half of employed female respondents (48.5%) with children in heterosexual couples reported spending an average of 2.17 hours per day on general household activities as compared to otherwise identical male respondents' 15 minutes per day of unpaid housekeeping labor (ATUS, 2018). Specifically, laundry, cooking, and general housecleaning are considered work to be completed by mothers and female partners in heterosexual relationships (Giménez-Nadal et al., 2019). Between 2013 and 2017, mothers who worked full-time reported spending a daily average of 49 minutes preparing meals and 44 minutes cleaning the house. No data on laundry was available in this specific data set (ATUS, 2018). Such inequity in household tasks, and the overrepresentation of women in unpaid labor, likely influences early childhood categorization of gender and children likely learn that work in the home is the responsibility of girls and women.

Peer influence on gender schema construction. Child play has long been considered foundational in the building of rudimentary understandings of social, emotional, and cognitive skills among children (National Scientific Council on the Developing Child, 2004). As children engage in play with peers, gender norms begin to formulate. Serbin and colleagues (1982) found that boys between the ages of 3.5 and 5.5 years tend to use more directive language and commands, and are encouraged to do so by same-sex peers, whereas same-aged girls tend to use more passive and polite suggestions to influence peers. Leaper (1991) further supported this notion by observing 5- and 7-year-old boys engaged in controlling styles of speech whereas girls interacted with peers with more collaborative speech styles while playing. Overall, these studies highlight the reinforcement of gender beliefs that boys should be more forceful and demanding in order to adhere to the expectations of masculinity while girls are expected to be more docile and accommodating (Price-Feeney et al., 2018).

Quinn and colleagues (2002) determined that by the age of 3 months, children are able to differentiate between male and female, even when gender-identifying clothing and appearances are controlled. Infants also exhibit a preference for peers, suggesting categorization of peer identities in relation to their own occurring early in the life cycle (Sanefuji, et al., 2006). Such early attempts to categorize others in relation to oneself emphasizes the urgency given to the early establishment of a *collective identity*, or a collection of individuals that share some number of common characteristics, amongst peers (Ashmore et al., 2004).

For children, there is an explicit differentiation between the collective identities of boys and girls; boys are expected to be strong, brave, and big, whereas girls are expected to be talkative, clever, and hardworking (Bennett, 2011). A trend also seems apparent that children have a strong desire to adhere to the standards expected of their gender classification. Bennett and Sani (2008) found that by the age of 5, children reported more gender-stereotypical behavior when they were around their same-sex peer groups as compared to when they were alone. Banerjee and Lintern (2001) concluded similar findings with 4- to 6-year-old boys, who gave self-descriptions that were more gender-stereotypical when they were among peers than when they were alone, further indicating that inclusion in an established collective identity, particularly one where gender is the common characteristic, is ubiquitous in early childhood.

Non-conformity within a gendered-collective identity can result in transformational repercussions for children by their peers. *Biased-based peer victimization* refers to a collective social group targeting individuals initially appearing to belong to their group but displaying behaviors inconsistent with those generally approved of or accepted by the group as a whole (Bradshaw & Johnson, 2011). More specifically, gender-related bullying is common, particularly among boys, within peer groups in which masculine members do not accept same-sex members

who do not adhere to gender-stereotypical behavior (Killen & Stangor, 2001). Behavior that does align with anticipated gender norms is stamped out; for young boys, collaborative, nonaggressive play may lead to physical consequences or being ostracized from male peer groups. For girls, play that is forceful and aggressive may result in being the victim of physical or social bullying (Bradshaw & Johnson, 2011).

Social ostracization is a common consequence for children who do not adhere to the gender-stereotyped behaviors of same-sex peers and can lead to a decline in academic motivation and success, difficulty forming adaptive social interactions, and a decline in overall mental well-being (Buhs et al., 2006; Martin & Fabes, 2001). As children tend to spend more time amongst peers, specifically same-gender peers, by the age of 6 years (Maccoby & Jacklin, 1987), difficulties with peer socialization can be particularly damning and long-lasting in a child's development and establishment of a gender identity. Given the amount of time that children spend with peers once they reach school-age, a child's ability to adapt and join social groups amongst same-sex peers may be among the most critical components of identity development during early childhood. Whether those peer groups accept or reject the child reinforces that child's place within their identified collective group and influences a child's self-efficacy in how they view themselves in comparison to their peer majority.

Personal Interests and STEM Career

Eventually, the lessons learned in childhood manifest into deliberate steps towards career development as children mature into adults. Previously received support in novel endeavors and the level, or lack, of self-efficacy and mastery in subjects become maintained or eliminate interests for career pursuit. Maintaining interest is a key component in career development for as long as interest is maintained, career avenues associated with those interests are not eliminated

(Gottfredson, 2005). Subject interest is a core component of many career assessments used to help individuals determine potential career options. However, another key component in career decision is the importance of money, as fiscal reward can be a strong motivator for the decision to pursue a specific career path (Dik, 2006; Heaton et al., 1993).

In 2019, Bureau of Labor Statistics (BLS) listed the 20 most profitable professions for the previous year. Careers that fall within the domain of science, technology, engineering and mathematics (STEM) occupations comprised 85% of the most profitable occupations for 2018 (BLS, 2019). There is no singular definition of careers that qualify as "STEM" occupations, however there are a number of common attributes utilized to identify a STEM-rooted occupation. Generally, STEM careers are identified as falling into one, or more, of six main categories: computers; mathematics; architecture; engineering; healthcare; social sciences (Vilorio, 2014). The salient underlying feature of any STEM career is the ability to utilize analytical, problem-solving-oriented thinking to identify a problem, investigate how to solve it, and employ appropriate means by which to do so (Terrell, 2007; Vilorio, 2014).

STEM Careers Outlook

Approximately 8.6 million STEM jobs were created in 2015; the BLS estimates between the years 2016 and 2026, approximately 436,200 new jobs that require a bachelor's degree will be added in the areas of healthcare and information technology (IT) alone (Torpey, 2018). In addition to the creation of these new jobs, 2017 median salary data for STEM occupations displayed markedly higher compensation than non-STEM careers $70,000 annually for registered nurses, $101,790 annually for software developers, $81,100 annually for network administrators, $95,060 annually for electrical engineers, and $85,880 for mechanical engineers, as compared to the noticeably lower median salaries of non-STEM careers during the same time

period: $44,380 annually for social workers, $59,300 for public relations specialists, $57,160 for elementary school educators, $59,170 for secondary school educators, and $69,350 for accountants (Torpey, 2018). Data from 2005 evidenced the national average of annual earnings for STEM employees was 70% higher than the national average for all employees (Terrell, 2007) and more recent data reported that 93 of the top 100 STEM occupations pay more than the national average (BLS, 2009; Fayer et al.2017; Terrell, 2007).

Not all STEM careers are on the same growth trajectory, however. Recent data shows that 70% of growth as measured by jobs added and salary distribution within STEM fields are in the fields of information technology (IT), software development, and information systems technology (Fayer et al., 2017). Computer-related occupations are expected to top growth in STEM occupations with an estimate of 500,000 new jobs added by the year 2024 (Fayer et al., 2017).

Women in STEM Careers

In 2015, the National Science Foundation determined that women represent 23% of the STEM labor force (NSF, 2015). Within STEM careers, women are primarily found among health professions and social science careers, comprising 87% of the workforce in the two STEM. subdisciplines. Though women comprise the majority in these two STEM fields, health professions and social science careers are among the lowest paying careers among all STEM fields and have the lowest projected growth rate between 2019 and 2024 (BLS, 2017; NSF, 2018; Pew Research Center, 2018). Among the fastest growing and highest paying STEM occupations between 2019 and 2024, namely computer science and engineering fields, women represent only 25% and 14%, respectively, of the workforce (NSF, 2018). The skew in

representation implies the perpetuation of inequity for the foreseeable future in the occupational categories with the highest rates of financial security and job opportunity.

History of vocational gender inequality. The division of labor between men and women has long been a part of the human condition. It is traditionally believed that in prehistoric era, women were the gatherers of grain and vegetables while men owned the responsibility to hunt (Herlihy & Watson, 2012). While women have been chronicled as contributing much more to the overall success of prehistoric society outside of gathering plants (see Owen, 2005), women's vocational history stems from the notion that the occupational foundation for women was to birth and care for children and gather food while men hunted (Rohrlich-Leavitt et al., 1979; Herlihy & Watson, 2012). As time progressed, women were regularly relegated to lower social standings than men. As an example, during the era of Grecian antiquity, women were expected to remain in the homestead to birth and rear children, having few rights; an estimated 80% of women were enslaved during this era (Attkinson & Hacket, 2004; Cartwright, 2016). Historically in the United States, men were considered more valuable members of society, exercising privileges such as voting or purchasing property, until social gains via the Women's Suffrage Movement in the 20th century (Attkinson & Hacket, 2004; Helihy & Watson 2012; National Parks Service, 2015).

Occupational trends since 1942 have resulted in better representation for men and women in different clusters of occupations (Moen, 1992). Historical economic advantages have allowed men to be better represented across all occupational fields, particularly occupations that require advanced levels of education (physician, lawyer) as well as careers that favor physical labor (Moen, 1992; Bureau of Labor and Statistics; 2010; Capuzzi & Stauffer, 2010; Census Bureau, 2019). Women are found in greater numbers in occupations that are lower paying, require less

education, and are more social in nature (Moen, 1992; Capuzzi & Stauffer, 2010; White House Council on Women and Girls, 2011). Occupations such as beautician, elementary school teacher or secretary, colloquially known as “pink collar jobs”, are commonly held by women and stereotyped as some of the expected career options for women (Capuzzi & Stauffer, 2010).

Occupational segregation, while still persistent, is shifting over time. The number of bankers, human resource professionals, and law enforcement officers shifted from almost exclusively male occupations to having a majority of women or parity among men and women since 1950 (Yau, 2017; Census Bureau, 2019). According to 2017 Census data, women employees comprise the majority of the information (57%), finance (53%), and real estate (54%) industries (Census Bureau, 2019). Public relations and fundraising managers (72.8%), human resources managers (77.9%), event planners (76.3%) and psychologists (75.9%) are occupational fields in which women currently comprise the majority (Bureau of Labor Statistics, 2019). Women have also gained ground in industries that have historically been almost exclusively filled with men. On a national scale, women comprise 37.4% of lawyers; 40.3% of physicians and surgeons; and 47.5% of biological scientists (Bureau of Labor Statistics, 2019).

The praise for occupational gender parity is not universal, however. The number of women employed as mathematicians or actuaries is too low for BLS data to capture. Women remain highly underrepresented in positions of power, such as chief executive roles (26.9%) Census Bureau, 2019; Bureau of Labor Statistics, 2019). In the arena of computer sciences, women are severely underrepresented constituting only 19.3% of software developers, 24.9% of information security analysts, 10.3% of network architects, and 21.9% of miscellaneous computer-related occupations (Bureau of Labor Statistics, 2019). Despite the prediction of exponential growth in the number of computer sciences occupations, less than 20% of young

women enrolled in college at the undergraduate level are majoring in computer science, a decrease of almost 15% from 1995 (National Science Foundation, 2018). Women are also underrepresented in engineering fields: 16.3% chemical engineers; 13.4% aerospace engineers; 10.9% mechanical engineers; 14.8% civil engineers; 18.9% computer hardware engineers; women in agricultural, biomedical, environmental, material, mining, nuclear and petroleum engineering are too few to quantify (Bureau of Labor Statistics, 2019).

Much of the data that reflects vocational progression by women is reflecting occupational gains by White women. When demographic factors are included, particularly race and ethnicity, much of the progress that has been made by women comes to a halt. Approximately 5% of all Black women in the workforce can be found in science and engineering occupations and 6% of Hispanic women. Regarding education 71.6% of women in science or engineering majors are White, while over the previous 20 years, the number of minority women attaining science or engineering degrees continues to plummet (National Science Foundation, 2018; IPUMS, 2019).

Legislation for Equality

In conjunction with civil rights movements to ameliorate the status and treatment of women in the overall social context, several pivotal pieces of legislature have been implemented over the course of U.S. history to obviate labor discrimination. The Fifth Amendment of the United States Constitution explicitly states that the federal government does not have the authority to deprive citizens of “life, liberty, or property” without due process (Esmaili, 2017). The Fourteenth Amendment compounds on the protection to individual freedoms through prohibiting states from infringing on any rights that would violate equal protection among all citizens through the law (Esmaili, 2017).

The Fair Labor Standards Act of 1938 established a minimum wage for all workers to receive, created an overtime program for laborers to be adequately compensated for working over the 40-hour weekly standard, prohibited child labor, and implemented methods of recording time worked by employees (Department of Labor, 2016). While this act was passed with intention to address wage discrimination, men comprised the overwhelming majority of the American workforce in the late 1930s. During the 1940s, however, global war called many of those men to serve in roles in the military, leaving occupational vacancies across the country that women would assume and flourish in during the course of the war (Hartmann, 1982).

During the global skirmish known as World War II, the number of American women in the workforce grew by 6.5 million, comprising 35.4% of the American work force in 1944 and 36.1% in 1945 (Hartmann, 1982). At the peak of the War, over 19 million women were in the American work force, coinciding with the declination of the percentage of women working as domestic servants, down from 17.7 to 9.5, as well as the proliferation of women working in factories from 20% to 30% (Hartmann, 1982; O'Neill, 1993). While American women experience occupational liberty like never before, one truth still remained: men earned more than women. While women comprised 4% of the skilled labor force during the War, women were paid a weekly average of $31.21 while men were paid a weekly average of $54.65 for the same jobs (Hartmann, 1982). Upon the conclusion of the War, 61% to 85% of women reported that they wished to keep their jobs, however many were let go from their posts as men returned stateside from the battlefield (Hartmann, 1982). During the 1950s, women who were in regions of the country that had a higher rate of mobilization during the War, i.e. a higher number of men who were enlisted and deployed to the various theaters of the war, enjoyed greater economic and occupational liberty as employment was more readily available for women in high-mobilization

areas than for women in regions where fewer men were drafted for the war (Acemoglu et al., 2004). While some women might have benefitted from some level of protection to geographic positioning, women nationally were still in a struggle to earn at the same rate as men both during and after the War (Aldrich, 1989).

The Equal Pay Act (EPA) of 1963 amended the Fair Labor Standards Act by providing federal mandates prohibiting wage discrimination due to sex (Esmaili, 2017). While previous attempts had been made to ensure that women were paid equally for equal skill and volume of work to men (see Women's Equal Pay Act of 1945), not until 1963, when President John F. Kennedy signed the EPA in to law, did women receive federal protection directly addressing the gaps in pay between men and women (Esmaili, 2017; National Park Service, 2016). In the following year, the Civil Rights Act of 1964 was a landmark for federal protections for many social areas, however Title VII of the Act specifically prohibited employment discrimination based on race, religion, sex or nation of origin (Esmaili, 2017; United States Congress, 1963). Included in this Civil Rights Act of 1964 was the establishment of the President's Committee on Equal Employment Opportunity, later becoming the Equal Employment Opportunity Commission (EEOC), whose unilateral mission was to ensure that the protective provisions of the Civil Rights Act were enforced (Collins, 2009; Esmaili, 2017). While the provisions in Title VII increased federal protections, not all employers were covered by these provisions, especially within the private sector. In addition, specific state laws may have been required to accept and proceed with the federal mandates, however state-specific employment practices (e.g. "at will" employment) provided employers legal means to enforce discriminatory practices that fulfilled the requirements of the law.

Most recently, in 2009, the Lilly Ledbetter Fair Pay Act was signed in to law which overruled a Supreme Court decision which restricted the allowable time period that an employee had to take legal action against an employer that had been proven of engaging in discriminatory compensation practices (The White House, 2009; Equal Employment Opportunity Commission, 2013). Federal legislation to protect women from employer discriminatory practices have waxed and waned, and while tangible progress towards equality has occurred, equality is still out of reach. The Equal Rights Amendment (ERA), for example, which would provide equal rights for all Americans, regardless of sex, was passed by Congress on March 2, 1972. At the time of this writing on September 1, 2019, 37 of the 50 states within the United States have ratified the ERA. Unfortunately, without a three-fourths approval, the ERA is one state shy of Constitutional ratification, negating equal protection based on sex for American citizens in 13 states (Alice Paul Institute, 2018; Salam, 2019). Failure of national ratification of an amendment that provides equal rights based on sex is one of many ways that women have failed to be equally protected by the law in the same manner as men and has implications for women's experiences in the workplace.

Sexism in the workplace. As women entered the workforce in greater numbers, they encountered personal and systemic sexism that, though changed due to time and legal protections, remains prevalent today. Survey data gathered in 2017 of 4,914 adults employed in STEM career fields yielded 42% suffering negative consequences, such as being treated as if incompetent or receiving less support from senior leaders than peers, due to their biological sex (Pew Research Center, 2017). There are two distinct forms of sexism in the extant literature: hostile and benevolent (Glick & Fisk, 1996; 2001). *Hostile sexism* refers to an adversarial portrayal of non-male-identified people resulting in an oppositional, uncomfortable, and even

threatening atmosphere for an individual of a different gender (Glick & Fisk, 1996; 2001). *Hostile sexism* towards women in the workplace may include the application of administrative policies that put women at a clear disadvantage as compared to men, using sexually explicit phrases and behaviors towards women, or other actions that indicate women are inferior to men (Glick & Fisk, 1996; 2001).

Benevolent sexism refers to engaging with women as creatures that are meant to be protected, supported, and admired by men (Glick & Fisk, 1996; 2001). Benevolent sexism, while on the surface seemingly innocuous, is a subtle form of prejudice which fosters an overall belief that women need men in order to survive and flourish, condoning a continued power imbalance and crystallization of gender roles under the guise of being something beneficial for both men and women (Glick & Fisk, 1996; 2001). Dependence on men to establish themselves in positions of power and then utilize their position to empower women is at the core of benevolent sexism. Any and all progress that women attain must be due to the selflessness of men in power helping to advance female colleagues, in turn advancing all women's progress towards equality (Glick & Fisk, 1996; 2001). In interpersonal relationships, benevolent sexism can be deceptive, fostering a *glass slipper effect* where women unknowingly support benevolent sexism, believing it to be romantic chivalry and increase the possibility of hostile sexism occurring later in the relationship (Rudman & Heppen, 2003). Negative associations between career interests and adherence to the glass slipper effect were evidenced in a study of 77 women in which women who fantasized more about finding a male partner that fulfilled the traditional male sex-role of "protector" or "White Knight" had lower career ambitions and were more likely to settle for careers with less financial reward and growth opportunities. Conversely, women who harbored fewer fantasies about male partners that fulfilled traditional sex-roles indicated higher levels of career ambition

(Rudman & Heppen, 2003). Thus, the presence of benevolent sexism, even outside the workplace, may ultimately prevent women from pursing ambitious careers.

Benevolent sexism perpetuates the notion of *proxy privilege*, which is the idea that White, straight, cisgender, Christian men in positions of power and wealth serve as the gatekeepers for who will benefit and the control the extent of that benefit with no fear of reprisal should they deny progress to anyone deemed unfit (Liu, 2018). Benevolent sexism, too, reinforces patriarchal systems and quells the autonomy of women to fight for vocational equality (Glick & Fisk, 1996; 2001). The establishment of a benevolent sexist environment ensures that any woman who seeks power on her own volition is then categorized as someone who can justly be treated harshly (Glick & Fisk, 1996; 2001).

Mothers in the work place. Women who choose to have children are particularly susceptible to educational and employment discrimination. For new mothers, difficult decisions, such as whether to take time off from work, are posed early during the transition into motherhood. In 1993, the Family Medical and Leave Act (FMLA) was passed by Congress which allowed individuals to take up to 12 unpaid weeks off from work per year to care for a newborn or sick child (United States Department of Labor, 2012; Esmaili, 2017). Prior to this act by Congress, women were not guaranteed any form of federal protection from losing their jobs were they to become pregnant or require time off from work to give birth to a child (Laughlin, 2011; Smith et al., 2001; United States Census Bureau, 2018). While the FMLA protections provide some support for working mothers, the effectiveness of the benefits are questionable. Brandeis University (2016) found that only 35% of all women could afford to take advantage of unpaid leave. The majority of those women were White; only 30% of African American mothers and 25% of Hispanic mothers were able to utilize the unpaid time provided by FMLA (Brandeis

University, 2016; National Partnership for Women & Families, 2016). Women of color are also more likely to be employed in lower-paying and part-time positions, neither of which accrue paid time off nor receive protected leave through FMLA (Klerman et al., 2012; Jorgensen & Appelbaum, 2014).

Decisions regarding how a new working mother could attend to her infant's nutrition have only been addressed within the last decade with federal protection. Prior to 2010, mothers had to make decisions regarding the logistics of how to feed their infant if they desired to breastfeed their child. The Fair Labor Standards Act was amended with the addition of Section 7(r) which required employers to provide safe areas where mothers could express breast milk, finally addressing natural feeding (Department of Labor, 2010). Almost three quarters of a century passed between the original passing of the Fair Labor Standards Act in 1938 and the ratification of Section 7(r) in 2010 relieving mothers of the burden of solving the logistical question of how to provide basic nutrition for their child and address the responsibilities to maintain employment, showing a stagnant sense of urgency to provide fundamental protection of womens' status as mothers. Though protections for working mothers exist, employer bias toward working mothers continues to impact women's job prospects (National Partnership for Women & Families, 2016; Ridgeway & Correll, 2004). Thus, pregnancy, children, and simply being a woman of reproductive age may deter employers from offering positions to women, particularly when the position is supervisory, high-paying, or male-dominated, including STEM positions.

Gender wage gap. A major source of inequality within occupation is the significant and persistent wage gap between male and female workers in the United States. In 2016, the median employed woman earned 83 cents for every dollar that men earned (Pew Research Center, 2018). World Economic Forum (WEF) published their annual Global Gender Gap report showing that

in 2018, the global gender wage gap decreased 3.6% across all business sectors since 2006. As of September of 2019, it was predicted that the gender wage gap will not entirely close for another 108 years, assuming that all trends remain constant (WEF, 2018).

Rates of gender inequality across career fields are fairly consistent. In 2018, men were found on 83.6% of the boards of publicly traded companies whereas women were found on only 16.4%; approximately 50% of a woman's daily work is comprised of unpaid labor, primarily due to labors related to family/home upkeep as compared to men's 31.5% of daily unpaid labor; 22.7% of employed women fill part-time, non-benefits eligible positions whereas only 12.9% of employed men do so (WEF, 2018).

In 2017, pay earnings for women ages 16 years and older totaled 81.8% of the earnings of men 16 years of age and older (BLS, 2018). In 2019, the United States women's national team, a perennial favorite to win any global tournament, won the Women's World Cup soccer tournament. While the victory on the field was decisively in the women's hands, another battle was to be waged in the courtroom as the women's national team fought for equal wages to that of the men's national team. Players on the Men's national team have an ability to earn a total of $1.1 million for a single victory in the World Cup tournament while the Women's national team would earn a maximum of $200,000 for winning the World Cup (Adams, 2019). For the 2018 Men's FIFA World Cup Tournament, the financial prize for winning the tournament was $400 million; in 2019 the financial prize for the women's tournament was $30 million, 7.5% that of the men's earnings (Hess, 2019; FIFA, 2018).

The wage gap disparity among professional soccer players is a high-profile instance of the division between wages among men and women across less conspicuous industries. In 2017, the industries of finance, judges/judicial workers, and personal financial advisors were found to

have some of the largest gender wage gaps with women earning 49.2%, 64.4%, and 65.8%, respectively, of what men earned. Women's earnings were equal to, or higher, than men's earnings in just 3% of occupations (US Census Bureau, 2017).

A disparity in take-home wages between men and women is problematic; however, there are also long-term implications of the wage gap. In preparation for retirement, many individuals opt into plans offered by their employer, particularly 401(k) plans wherein individual contributions are matched to some degree by their employer. For men, higher wages allow for the opportunity to contribute greater amounts of their pay to retirement, which in turn leads to a greater fiscal investment on behalf of their employer, as compared to women (Ziv, 2019; Internal Revenue Service, 2019). To quantitatively illustrate this, a calculation by Vanguard investment management showed that the national average for percent match by an employer was 4.3% in 2019. If two employees receive a match of 4.3% but one makes an annual salary of $60,000 and the other makes an annual salary of $50,000, the former will receive $2,580 in matching funds while the latter will receive $2,150, an initial difference of $430. If we extrapolate those numbers to be representative of the current wage gap, we could say that Manager A (male) makes $100,000 annually and Manager B (female) makes $80,000 annually. Over the course of a 30-year career, Manger A would have $52,000 more in their retirements savings than Manager B. Therefore, women in the workforce with lower take-home earnings based in salary, earn less over the lifetime, but also, in turn, accrue fewer lifelong benefits of work including retirement funds (Forbes, 2019; Vanguard, 2019).

Gender inequality in STEM Careers. On a global level, women are markedly underrepresented in STEM career fields (Hauman et al., 2012). According to the most recent data from the National Science Foundation (2017), women comprise only 12.7% of engineering

occupations and 25.1% of all computer- and math-related occupations. In total, women constitute 27.5% of the entire STEM workforce. In fact, the number of women employed in computer-based occupations, such as network engineers, computer scientists, data scientists, etc., declined from 32% in 1990 to 25% by 2016 (Pew Research Center, 2018). LinkedIn, the social media platform for career professionals, in collaboration with WEF, determined artificial intelligence (AI) specialists were the fastest growing occupation represented, globally, on their platform; women constituted 22% of global AI specialists (WEF, 2018). The underrepresentation of women in the AI field is an example of how expanding career fields lack comparable representation among genders and may perpetuate the disenfranchisement of women while perpetuating workforce dominance for men.

As previously mentioned, men comprise the majority of the labor force in the highest paying STEM career fields, representing more than three times the number of women in computer and mathematical occupations, with women underrepresented and commanding only 79.6% of the earnings as compared to their male counterparts (BLS, 2018). With fewer women participating in STEM careers than men, gender pay disparity will likely continue to persist in high-growth and high-paying jobs of the future (BLS, 2018), continuing historical trends of men monopolizing lucrative career paths in which women are discouraged from participating and ultimately controlling larger portions of wealth.

Development of STEM Career Interest Among Girls and Women. Participants' friend groups were a primary predictor in women's motivation to continue STEM career pursuits. A lack of peer support in academic environments is a primary contributing factor to women being underrepresented in STEM careers. Utilizing data from 468 high-school participants (204 boys, 264 girls) between the ages of 13 and 18, Robnett and Leaper (2013)

found that peer groups and internal science interests were the strongest predictors of STEM career interests. Their analysis found that male students who were interested in science reported higher levels of interest in STEM career interest as well as higher levels of peer support for their career interests than male students with no science interests. Female students with high levels of science interest also indicated higher levels of STEM career interests than female students with lower science interests. Most notable, however, was the finding that female participants with fewer friendships with female peers reported the highest levels of STEM career interests, suggesting that STEM career interest among girls and young women are greater for those with higher levels of interest in science and fewer female friends. The researchers concluded that when girls have more relationships with other female peers, gender-norms were reinforced and STEM interests were minimized. However, when girls had more mixed-sex friendships, STEM interests were seen as gender neutral and STEM career interest levels were maintained (Robnett & Leaper, 2013).

Falco and Summers (2017) produced another study where they introduced 88 girls in high school to interventions specifically designed to foster STEM self-efficacy. Participants in their study attended 50-minute group counseling sessions designed to improve career decision self-efficacy and STEM self-efficacy. Group sessions occurred once a week for a total of 9 weeks. They found women to be more likely to engage in STEM career development when self-efficacy within STEM was developed. Additionally, among the experimental group, improvement in STEM self-efficacy and career decision making continued 3 months after the intervention concluded (Falco & Summers, 2017). Their study evidenced the immediate impact that self-efficacy has on the proliferation of STEM career interests that the current study observed. An additional study which analyzed the role that self-efficacy played among girls who

represented minority communities also indicated that self-efficacy was critical in continued STEM career interest (Gremillion et al., 2019). The researchers analyzed the responses of 154 girls enrolled in public high schools and found that higher girls who are more self-efficacious had a significantly higher amount of interest in STEM academic areas, specifically mathematics and science, as well as more pronounced STEM vocational aspirations. The findings of the current study align with the observed pattern of self-efficacy making a vital contribution towards stimulating and maintaining STEM academic interests and career aspirations for girls and women.

Sexual harassment is another major deterrent in persistence of STEM career interests by women. Those that reported experience of sexual harassment or negative gender bias by friend groups were more likely to discontinue STEM related studies, however a positive correlation was also reported between peer support as a primary motivator towards continued STEM interest among female STEM majors, confirming findings in the previous study (Leaper & Starr, 2018; Robnett & Leaper, 2013). In a study with 685 undergraduate women in STEM-related majors, Leaper and Starr (2018) found that the majority of women (70.6%) reported having experienced sexual harassment by an instructor on at least one occasion in the year prior to completing the survey. A study among 525 graduate students on sexual harassment in academic settings resulted with proportion of female students (38%) reporting sexual harassment from their faculty or staff and over half (57.7%) reporting sexual harassment from other students. Experience of sexual harassment by an authority figure in the field has been associated with distrust in the institution and a lack of self-confidence in the field (Rosenthal et al., 2016). Thus, academic environments serve as a gauntlet for many women interested in STEM-related subjects. With the facilitation of environments that fail to hinder sexual harassment and a lack of positive support by peers,

women are likely to discontinue pursuit of STEM-related education, contributing to the lack of equal representation of women in STEM careers.

Impostorism, or the attribution of success due to luck and external factors and not due to internal ability and skill, is another mitigating factor in the underrepresentation of women in STEM careers (Clance & Imes, 1978). In a study of 224 women enrolled in STEM-related doctoral graduate programs, Tao and Gloria (2018) found that increased rates of impostorism among women in graduate school were negatively associated with levels of academic self-efficacy and attitudes towards persistence to complete their graduate degree. In accordance with SCCT, women engaged in STEM-related learning or professions who believe that their success is fraudulent and lack self-efficacy in their work may be vulnerable to discontinuing pursuit of STEM careers.

Increasing Opportunity for Girls and Women in STEM

Important federal legislation promoting gender equality was advanced via the Education Amendments of 1972. Among this set of amendments was the inclusion of Title IX which prohibited discrimination in funding on the basis of sex for any institution of education that received funds from federal sources (United States Congress, 1972; Department of Justice, 2012; 2015). Title IX addressed discriminatory practices implemented by institutions of higher learning including prohibiting women from participating in academic programs, setting quotas for the number of women admitted, and requiring women to score higher than their male counterparts to gain admittance to universities (Department of Justice, 2012; 2015). Since the enactment of Title IX, the number of women who graduated with at least a high school diploma has risen from 59% in 1970 to 87% in 2009; the number of women who have at least a college degree has risen from 8% in 1970 to 28% in 2009 (White House Council on Women and Girls, 2011). During the 2007

– 2008 academic year, women comprised the majority of enrolled undergraduate- (57%) and graduate-level (59%) students and accounted for 57% of all college degrees conferred (White House Council on Women and Girls, 2011).

Education and STEM. While almost all STEM occupations require additional education after high school, 73% of STEM careers do not require education beyond a bachelor's degree (Fayer et al., 2017). Statisticians, IT security analysts, software developers, and biomedical engineers are projected to be the fastest growing career fields over the next five years and each require no further education beyond a bachelor's degree (Fayer et al., 2017). Additionally, the Department of Education (DoE) initiated STEM training programs to help address the needs of the workforce for STEM-trained professionals over the course of the next five years (Federal Register, 2018; NSTC, 2018). The DoE's initiative to invest in early STEM education includes upholding a $200 million directive by the Office of the President to collaborate across government agencies to provide grants and other funding to promote early educational opportunities in STEM learning (Federal Register, 2018) including earlier access to advanced mathematics for middle-school aged children as well as emphasis on computer science at the high school-level (NSTC, 2018). These initiatives hope to not only address growing needs for STEM workers, but to also provide opportunities for career-relevant education and facilitate opportunities for those not able, or without desire, to go to college an opportunity to join the growing STEM workforce (NSTC, 2018).

Gender Similarities in STEM-Related Skills. Janet Shibley Hyde (2018) suggested that the reported differences between genders in extant scholarship were due, in part, to researchers' almost exclusive focus on those differences. The majority of psychological research on gender tends to explore and emphasize differences between genders, stemming from the colloquial

concept that men and women are fundamentally distinct in several salient categories. This almost universal focus on differences creates a narrative that masks the similarities that are present among genders.

Hyde (2018) cited two early works, Maccoby's (1964) book *The Development of Sex Differences* and Maccoby and Jacklin's (1974) *The Psychology of Sex Differences* as primary influences in shaping the focus of psychological development and calcifying general cultural knowledge on the differences between men and women. While earlier works drew attention to the differences between genders (see Woolley, 1914 and Hollingworth, 1918), Maccoby and Jacklin (1974) found that most areas of difference were minimal with the exception of four primary areas: verbal ability, visual-spatial ability, mathematical ability, and aggression. This finding influenced generations of education, and perception of ability based on gender, for girls and women.

Hyde (2018) found that while there may be overall differences in these primary areas of difference, analysis of the facets that comprise the overall scales used to measure them told a richer story. Visual-spatial reasoning, for instance, is comprised of numerous facets including spatial visualization, which was similar between genders with a total effect size of $d = .13$, representing a hardly noticeable difference between men and women (Hyde, 2018). Mental rotation, however, produced an overall effect size of $d = .73$ in favor of men's ability to mentally rotate objects better than women (Hyde, 2018). A difference in this one facet is markedly different than the assertion that men are broadly better at visual-spatial tasks than women. Training might bridge the gap in cognitive differences. Further, it is impossible to know how decades of differences in educational experiences and messages about girl's/women's inferiority in such skills impacted the acquisition of such skills.

In a study of 14 women between the ages of 18 and 32 with no prior video game experience, exposure to a total of 10 hours of first-person, action video game play, wherein the player controls various virtual participants in a recreation of World War II, in 1- to 2-hour intervals over the course of 4 weeks resulted in an increase in cognitive-spatial scores during a post-test intervention (Feng et al., 2007). An all-male group (n = 6) played the game *Ballance*, a 3-D game where players were tasked with steering a ball through obstacle-filled mazes. In the post-intervention assessments, spatial reasoning scores between the male and female groups were indistinguishable. The 14 female participants scored as well as the 6 male participants in useful-field-of-view tasks where participants indicated the direction that a stimulus entered their field of view. The improvement in spatial-reasoning performance after the video game intervention suggests that emphasis on perceived differences between men and women are diminished with adequate training (Feng et al., 2007). Thus, even those abilities demonstrating significant differences between boys/men and girls/women may represent differences in what is taught rather than capabilities.

Further research has supported the lack of dramatic differences among genders, even in those notions that are colloquially accepted as true. Girls' ability in mathematics, for example, has traditionally been believed to be poorer than that of boys by parents, teachers, and among girls themselves (Cavanagh, 2008). This notion has been challenged, however, as multiple studies found that school-aged girls perform just as well as school-aged boys in grade appropriate mathematical skills (Hyde et al., 2008; Scafidi & Bui, 2010). Through meta-analysis, Hyde (2005; 2018) found that the effect sizes for gender differences in 78% of the 128 total cognitive and achievement categories compared were less than $d = .35$. In the light of these

findings, were environments constructed to provide more focus on the similarities among gender, presumed differences among genders might be mitigated.

Video Gaming

Video games are an electronic form of media where individuals can manipulate images and characters on a television screen or some other electronic display screen (Coyne et al., 2018; Merriam-Webster, 2019). In 2019, video games are played across multiple platforms including smart phones, computers and dedicated electronic gaming consoles such as Playstation or Xbox (Microsoft, 2019; Sony Interactive Entertainment, 2019). Video games, like other forms of media, are comprised of gaming content comprised from a myriad of different genres, including action/adventure, sports, first person, role-playing and puzzle games, all with their own unique story-telling and gameplay styles (Ray, 2018). Some necessary skills for success in video games, including developed spatial reasoning ability, are also identified as predictors of success in STEM careers (Blickenstaff, 2005); therefore, video games may serve as a means by which to increase STEM interest and motivation.

History of Video Gaming

To understand the rise in popularity of video games, a history of the gaming industry in the United States is essential. Video games were initially utilized in labs for academic purposes. In 1952, A.S. Douglas created a tic-tac-toe video game as part of his doctoral dissertation at the University of Cambridge. Following in 1958, William Higinbotham created a game titled *Tennis for Two* using an analog computer and oscilloscope, and Steve Russel created a game titled *Spacewar!,* the first interactive computer game, while still a student at Massachusetts Institute of Technology (History.com, 2017; Kent, 2001). The Magnavox Odyssey console was the first home video game console, released in 1972. In 1975, Atari released *Pong* on home consoles and

shortly afterwards, in 1978, released the Atari 2600 which significantly increased the popularity of home consoles with games like *Space Invaders* and *Football* setting sales records (Kent, 2001).

In 1983, video games hit a generational peak in the U.S. (Lien, 2013). Atari was the dominating video game console at the time and titles such a *Pong*, *Breakout*, and *Centipede* represented the games of the era: simplistic, fun games that were not meant to appeal to any one demographic group or another but were intended for all. By 1985, however, the public had grown weary of simplistic games, and an industry that was valued at $3.2 billion in 1983 generated a cumulative revenue of only $100 million by 1985 (Kent, 2001; Lien, 2013). The video game industry was dying; however, a cultural shift provided the opportunity for the industry to be revived.

During the 1980's, toy stores reigned supreme. Institutions such as K.B. Toys and Toys-R-Us served as supermarkets for toys and child fantasies (Horowitz, 2018; Lien, 2013). Video game companies, led by Nintendo, realized that the key to revival was through having products in toy stores, but there also had to be a specific demographic to target with marketing ads in order to optimize sales (Lien, 2013). During the late 1980's and moving in to the 1990's, video game ads targeted boys with commercials depicting male adolescents playing video games with girls depicted as observers, in awe of their gaming abilities; video games were marketed to young men by including sexualized women on the covers and violent content; phrases like, "Nintendo Power" or product names such as the "Game Boy", caught the attention of young boys (Lien, 2013). By the end of the 1990's, the masculinization of video games was thorough and complete, leaving many female gamers absent from major marketing campaigns by the video game industry.

Current Trends in Video Gaming

The Entertainment Software Association polled 4,000 U.S. Americans about their video game habits and determined that approximately 65% of American adults reported regularly (i.e. 8 hours or more per week) playing video games. The average age of regular video game players was 32 years for men and 34 years for women. Most families (70%) had at least one child who regularly played video games and the overall gamer population was comprised of 46% women and 54% men. Though the video game industry has traditionally been dominated by men, including those that play video games as well as those who develop and sell them, the percentage of male and female gamers appears roughly equal (Shaw, 2012; Entertainment Software Association, 2019; Forbes, 2019).

In general, technologically advanced toys, such as video games, tend to fall into the "masculine" realm of gendered-play, yet this gendered view of gaming alienates many young girls and women who openly enjoy playing video games (Jansz, 2005; Gil-Juarez et al., 2018). The overwhelming masculine influence on video games can be seen through the predominant content contained in video games, largely focused on graphic depictions of violence and aggression that tie in to real-world activities (Cherney et al., 2014; Terlecki & Newcombe, 2005). Girls, however, tend to engage in more traditional video games where puzzle-solving is the focal point (i.e. Candy Crush), as well as games that emphasize richer, deeper narratives and contain less overall violence (Ferguson & Garza, 2011; Greenberg et al., 2010). Historically, games such as *Myst*, which focused on problem solving and character development without violence, have a gaming audience wherein women are the majority (Lien, 2013).

Virtual sexism and objectification theory. Depictions of women in video games likely contribute to benevolent sexism as they portray female characters as helpless, needing the heroic

actions of a male character that is commandeered by the game player (Dickerman et al., 2008). The *Mario* franchise is considered the best-selling video game franchise of all time with over half a billion (595.64 million) units sold and between 256 total titles totaling approximately $36 billion in revenue since its inception in 1981 (Fraser, 2016; Piccalo, 2017). The premise of many of the *Mario* titles consists of gamers playing as Mario, an Italian plumber, as they overcome a number of obstacles and enemies to rescue Princess Peach (née Toadstool), the damsel in distress (Claiborn, 2012; Nintendo, 1985). A multi-billion-dollar franchise that has been played across generations has continuously portrayed women as helpless unless rescued by a male character.

Consistent with the theme of masculinity dominating the realm of video games, there are few female protagonists. As few as 16% of playable characters in video games are women, with an additional 50% of women who are represented in video games serving as props in environmental surroundings or bystanders solely intended to move a story arc forward (Breuer et al., 2015; Glaubke et al., 2000). Of the female characters found in video games, many are portrayed in oversexualized roles, with exaggerated physical features to emphasize the character's sexuality (Breuer et al., 2015; Down & Smith, 2009). The American Psychological Association Task Force on the Sexualization of Girls (2007) defined the *sexualization* of women as the reduction of a woman to the sexual characteristics of her appearance and behavior while all non-sexual characteristics are ignored. Popular titles such as *Dead or Alive Xtreme 3* and *Bayonetta* (PlatinumGames, 2009; Team Ninja, 2016) portray female protagonists in an almost exclusively sexual manner, with the characters dressed in skin-tight body suits, bathing suits, and lingerie, filtering the character's actions through the lens of sexuality. Even the popular *Tomb Raider* franchise depicts a smart and powerful woman, Lara Croft, a storied archeologist, in a variety of sexualized attire meant to emphasize her body. Conversely, Indiana Jones, a similar

male character, is consistently shown with full-length khaki pants, usually a jacket, a shirt, and a hat. The hypersexualization of female protagonists offsets the characters' strength and power, suggesting that for a woman to be powerful she must also be an object of sexual desire.

Filmmaker and feminist film theorist, Laura Mulvey, coined the phrase *male gaze* to describe the manner in which women are depicted in media as pleasurable viewing objects for men (Mulvey, 1999). Male gaze is a facet of *objectification theory* which posits that repeated exposure to sexualized women in the media creates an internalized self-sexualization in which girls and women begin to see themselves as a collection of physical body parts that can be utilized for pleasure by others (Frederickson & Roberts, 1997; Linder et al., 2019). Burgess and colleagues (2007) analyzed 225 external covers of video games for sale and found that on covers that contained human characters, women were found on less than half (42.7%) whereas men were found on nearly all of them (90.2%). Of those covers that women were found, nearly all (84%) portrayed sexualized pieces of a woman's body (e.g., drawings of legs, breasts and buttocks), and almost half of the portrayals of full-bodied women emphasized sexuality via bodily position or choice of clothing (47.4%). Male characters were found to be objectified at a significantly lower rate (13.5%; Burgess et al., 2007). As such, the impact of male gaze in video game marketing is evident as women are regularly portrayed as sexualized objects.

Guizzo and Cadinu (2017) studied 107 White women between the ages of 18 and 31 years, analyzing the influence of male gaze on *flow*, a state in which one is at the peak of their cognitive ability while immersed in a challenging task that also elicits excitement and creativity (Csikszentmihalyi, 1990). Increased male gaze led to higher rates of flow disruption for women, indicating that male gaze not only negatively influenced self-esteem and body image, but also created cognitive disruptions for women (Guizzo & Cadinu, 2017). During childhood and

adolescence, when gender salience filters (GSF) are still being developed, children begin to associate strength in women with overt sexuality allowing male gaze to negatively influence a critical developmental period (Coyle & Liben, 2016; Ward, 2016). For some girls and women, sexualized female imagery may deter them from engaging in video game play. For young women who choose to play video games, almost exclusive exposure to women as sexual beings likely communicates that a woman's power lies in her sexuality, not her skills, intellect, or abilities.

Aggression in video game play. Numerous studies conducted on the impact of video games evidenced a positive association between violence depicted in video games and heightened displays of aggression (Anderson & Warburton, 2012; Coyne et al., 2018; Greitemeyer & Mugge, 2014; Warburton, 2014). Increases in aggressive externalized behaviors are especially applicable for boys, as boys play video games at an average weekly rate double that of girls (Greenberg et al., 2010). Boys also tend to display a preference for highly physical video games that imitate real world physical competition and actions (i.e. sports and first-person shooter genres), following modern trends in gaming which focuses the gameplay on the glorification of physical violence and aggressive male protagonists (Greenberg et al., 2010).

Aggressive behaviors in video games, especially those where gamers play online with others, frequently contain derogatory phrases targeted at ethnic, racial, and gender minorities, including women (Fox & Tang, 2014; Tang & Fox, 2016). The use of language and behaviors to discriminate in these arenas may be attributed to the liberty that the gamer feels through anonymity in conjunction with fantasy, i.e. it is not real because fictional characters are performing fictional actions in a realm that is fictional (Lea & Spears, 1991; Tang & Fox, 2016). It is undeniable, however, that gamers are openly engaged in acts of hostile sexism. A visit to

just about any arena of competitive gaming will provide an inevitable experience with “trash talk”, or jokes and insults, often consisting of vulgar language, meant to disparage and purposefully embarrass other gamers. Common among those insults are the use of words that have the historical connotation of belittling women (e.g. “bitch”), in addition to derogatory uses of terms associated with female sexual anatomy (Glick & Fiske, 1996; Tang & Fox, 2016). A subcommunity known as “salty gamers” exists within the overall gaming community wherein some gamers exhibit great difficulty losing and make regular use of the derogatory language in attempts to insult other online gamers (Gironi, 2019).

In a realm where open sexism and racism are present, the environment of online video games arenas cater to the stereotypical image of who a “gamer” is: a defensive White man (Salter & Blodgett, 2012; Shaw, 2012; Tang & Fox, 2016). Within the world of gaming, women are seen as outsiders and are particularly vulnerable to sexist harassment by others within the gaming community (Chess & Shaw, 2015; Fox & Tang, 2014; Tang & Fox, 2016). The use of technology to virtually harass others is known as *cyberbullying*. Although the parameters of what constitutes *cyberbullying* tend to vary depending on the perspective from which it is examined, the fundamental elements are non-physical harassment that occurs via electronic means (Kuwalski et al., 2014). A 2014 study by the Pew Research Center (Duggan, 2014) found that young women were particularly vulnerable to online harassment. In a poll of 2,839 men and women between the ages of 18 and 24, 50% of women reported having been called an offensive name, 26% reported being digitally stalked, and 25% reported experiencing sexual harassment online. Some respondents (16%) reported experiencing their most recent experience of harassment in any context was while playing video games online; 44% of participants reported that online gaming was an environment that was more welcoming for men than women. More

women (38%) than men (17%) reported that the harassment experienced online was “extremely or very upsetting”, indicating gender differences in the emotional experience of online harassment as well potential differences in the forms of harassment directed at women (Duggan, 2014). Thus, girls and women who may have interest and attempt to engage in video game play may be deterred by pervasive discrimination and harassment by male peers.

Participation in social video game play. Competitive video game playing has risen to such prominence that an entire industry, eSports, was created. The eSports industry is anticipated to surpass an annual revenue of $1 billion in 2019 (Newzoo, 2018), with players participating in tournaments for independent or team play to generate income and earn sponsorships from top companies in the industry (CNN, 2018). Despite the competitive nature, eSports-style gaming has been shown to facilitate prosocial cooperation and improve outgroup attitudes among players on the same team at the same rate as non-violent video games (Greitemeyer et al., 2012; Stiff & Bowen, 2016).

The facilitation of pro-social attitudes translates to facilitating positive relationships between segregated groups within a population (Adachi et al., 2016). The ability to stimulate comradery between gamers is a core component of the rationale to use video games in military training, as it enhances relationships between soldiers during their training (Orvis et al., 2010). In a study investigating the power of comradery elicited via video game play, 77 students (67% female, M_{age} = 18.7 years) from a Canadian university played *Call of Duty: Black Ops,* a first-person game where players controlled military special operations characters and soldiers in terrorist organizations and engaged in cooperative virtual combat with other students from a university in the United States. Participants were asked to complete an outgroup attitude ratings scale prior to engaging in game play and again upon the conclusion of 12 minutes of gameplay.

Improvement in outgroup attitudes were noticeable after 12 minutes of team participation even while engaging in violent video games, suggesting a relatively quick solution to improving relationships between participants (Adachi et al., 2016).

Social identity theory posited individuals are motivated to enhance the social groups of which they are a part, the *ingroup*, while relegating individuals not associated with the group as the *outgroup* (Tajfel, 1978; Tajfel & Turner, 1979). Social identity theory for gamers would presume that male gamers constitute the majority ingroup while female gamers comprise the outgroup. Stiff and Bowen (2016) found that participants from two distinct social identities (e.g. school affiliations) playing video games cooperatively with outgroup members facilitated relationships between the two groups and ameliorated the tension caused by the group differences. Their findings suggest relationships between male and female gamers may be optimized through collaborative play and decrease the presence of hostile and benevolent sexism.

In addition to competitive games that are fraught with violence, massive multiplayer online (MMO) video games have also been shown to foster a sense of community and belonging to participants who engage in these games (Frostling-Henningsson, 2009; Griffiths et al., 2003). Qualitative interviews with individuals who participate in MMO gaming reported common themes of the availability to express oneself through the video game and the ability to align their game character with their own personal beliefs that allowed the individual to feel comfortable with their personal expressions of authenticity. The liberty to remain authentic through video game characters resulted in more prosocial behaviors by gamers working together to defeat a common foe or reach a shared objective in the video game (Frostling-Henningsson, 2009). A strong trend is observable among female gamers in which they more readily engage in video

games that focus on prosocial characteristics and non-violent gameplay (Ferguson & Garza, 2011). While many games are marketed to young, heterosexual men and focus primarily on violence, gaming options such as MMOs, where the focus of the game is not centered on outright violence, may serve as an opportunity for male and female gamers to more frequently and collaboratively play video games together (Fox & Tang, 2014; Lien, 2013).

The Importance of Gender Equity Among Gamers

E-sports, or electronic sports where players compete in competitive games against one another, are gaining momentum and becoming a profitable career avenue for video game players, companies such as 2K Sports has created a developmental league to promote more young women participating in competitive video gaming (Good, 2019). Columbia College has instituted a Girls Who Game camp for young women to play video games in collaborative and safe environment to not only foster interest in playing video games but provide lessons in basic video game programming as part of the curriculum for young women. Through the Girls Who Game camp, young women between grades 6 through 12 have an opportunity to play award-winning titles and are given feedback and insight from game developers regarding the technical components of the game which the camp participants are tasked at the end of the camp to utilize to create their own novel games (Columbia College, 2019; Sanchez, 2019).

Through experiencing flow in game play, young women can gain a stronger sense of self-efficacy with their computer-skills. A 2012 study in Turkey found a positive correlation between gamers achieving a flow-state and increased self-efficacy with computer skills (Hong, Pei-Yu & Hsiao-Feng, 2012). For this study, 101 college students (56.4% female, 43.6% male) engaged in a Flash-based game called *Fire Escape*, developed by the university's Digital Learning Laboratory, where players controlled a character and made attempts to leave a building that was

on fire while also rescuing up to four additional characters in their attempt to escape. Players reported higher levels of flow and computer efficacy during post-test surveys given after 20 minutes of gameplay, however when players believed they were in competition with other players, the level of flow increased (Hong et al., 2012).

Video Gaming & STEM

Giammarco and colleagues (2014) conducted a study measuring video game play frequency and its relation to STEM career interests. Using a sample of 264 participants recruited through Amazon's Mechanical Turk (MTurk), the study found that among female participants (n = 136), women engaged in regular video game play (*M* = 9.32 hours per week) reported higher levels of male-dominated careers, including some STEM career fields, than women who did not play video games (Giammarco et al., 2014). Although the relationship between video game play and career was moderated by biological sex, they did not evaluate the impact of gender roles or the moderating effects of video game engagement on gender roles and STEM career interest. Engagement in video games has been shown to develop and maintain spatial reasoning and interest in facets required for employment in male-dominated career fields such as STEM (Bonner & Dorneich, 2016; Feng et al., 2007; Giammarco et al., 2014; Robnett & Leaper, 2013).

The Present Study

Video games may serve as an affordable, easily accessible, year-round intervention to build self-efficacy in STEM; however, fewer girls and women, as compared to boys and men, regularly play video games (Entertainment Software Association, 2019; Greenberg et al., 2010). The current examination will explore the relationships between career decision self-efficacy, perceived encouragement in STEM, adherence to traditional gender roles, STEM career interest, and science motivation. Specifically, it is hypothesized that 1) lifetime frequency of gaming will

be positively associated with STEM interest and motivation; 2) career decision self-efficacy will be positively associated with STEM interest and motivation; 3) adherence to traditional gender roles will be negatively associated with STEM career interest and motivation; 4) lifetime frequency of gaming will moderate the relationship between gender roles and STEM career interest and motivation, such that frequency of gaming will attenuate the relationship between gender roles and STEM career interest; and, 5) lifetime frequency of gaming will moderate the relationship between self-efficacy and STEM career interest and motivation such that as gaming frequency increases, the relationship between self-efficacy and STEM career interest and motivation is strengthened.

CHAPTER TWO

METHOD

Participants

A total of 300 participants completed our survey questionnaire. Only participants who had completed at least one of the survey measures and identified as a woman were considered in the final analysis. After filtering the total participant pool by gender and survey completion status, 114 participants were eliminated, 57 due to gender identification and 57 due to not completing at least one survey, resulting in 186 participants remaining for use in the final analysis. All participants endorsed their biological sex as female; gender identifications were cisgender (97.3), transgender (.5%), non-conforming (1.1%), and other (1.1%). Participants self-identified as White (77.4%), African American (11.8%), Asian American (3.2%), Hispanic (1.6%), Native American (0.5%) and Other (4.8%). Participants represented various collegiate classes with 17.2% identifying as first-year students, 21% identifying as second-year students, 21.5% identifying as third-year students, 21% identifying as fourth-year students, 4.8%

identifying as fifth year or more, 9.7% identifying as Masters students, and 4.8% identifying as doctoral students. Ages of participants ranged from 18 to 53 years (M_{age} = 21.61, *SD* = 4.66). Roughly half (50.0%) of participants reported their GPA was between 4.0 – 3.5, 29.0% reported a GPA between 3.49 and 3.0, 16.1% between 2.9 – 2.5, 2.7% between 2.4 – 2.0, 0.5% between 1.9 – 1.5, and 1.6% reported a GPA below 1.00; no participants reported a GPA between 1.49 – 1.00.

Measures

Gaming frequency. Gaming frequency (GF) was measured via self-report of the average number of days each week that a participant played video games over the course of their lifetime. More than half of the participants (57.5%) indicated playing video games during their lifetime. The number of days per week that participants endorsed playing video games were one day per week (7.0%), 2 days per week (6.5%), 3 days per week (15.1%), 4 days per week (7.0%), 5 days per week (10.8%), 6 days per week (3.8%), and 7 days per week (7.5%). A total of 42.5% of participants indicated that they had not played video games with any regularity during their lifetime.

Data was also collected via self-report measures for the average number of hours participants played video games per day over the previous 30 days. More than half (57.6%) indicated playing video games over the previous 30 days. The number of hours per day that participants endorsed playing video games were 1 to 30 minutes (20.6%), 30 minutes to 1 hour (15.0%), 1 to 2 hours (14.0%), 2 to 3 hours (15.0%), 3 to 4 hours (8.4%), 4 to 5 hours (10.3%) and more than 5 hours (16.8%). A total of 42.4% of participants indicated that they had not played video games at all within the previous 30 days.

STEM career motivation. The Science Motivation Questionnaire II (SMQ-II; Glynn, Brickman, Armstrong, & Taasoobshirazi, 2011) is a 25-item questionnaire that asks about scientific interests and motivations among college students along five factors: intrinsic motivation, career motivation, self-determination, self-efficacy, and grade motivation. Items are measured on a 5-point Likert-scale that ranges from 0 (never) to 4 (always). Sample items include, "Learning science is interesting" and, "I am sure I can understand science".

You, Kim, Black and Min (2017) applied the ratings scale model (RSM) method introduced by Andrich (1978) which specializes in testing Likert-based measures via the one-parameter logistic model, known as the Rash model. Resulting Chronbach's alpha values along the five factors showed intrinsic motivation ($\alpha = .89$), career motivation ($\alpha = .93$), self-determination ($\alpha = .85$), self-efficacy ($\alpha = .90$) and grade motivation ($\alpha = .83$) to have sufficient internal reliability to qualify as dependable factors for this model (Rasch, 1960; 1980).

STEM career interest. The Career Interest Questionnaire (CIQ; Christen, Knezek, & Tyler-Wood, 2014) is a 12-item measure that asks about career interest in scientific fields. The measure utilizes a 5-point Likert-scale that ranges from 1 (strongly disagree) to 4 (strongly agree). Sample items include, "I would enjoy a career in science" and, "I will get a job in a science-related area".

Gender roles. The Social Roles Questionnaire (SRQ; Baber & Tucker, 2006) is a 13-item scale measuring views on social roles among genders. Items utilize an 11-point scale wherein respondents indicate percentages ranging from 0% (strongly disagree) to 100% (strongly agree), in increments of 10. Sample items include, "Men are more sexual than women" and, "Only some types of work are appropriate for both men and women".

Baber and Tucker (2006) condensed the 41-item SRQ to a 13-item measure that was intended to be better suited for survey studies utilizing multiple measures. A varimax-rotated factor analysis was conducted on the 13 principal components of the scale and divided the scale into two distinct factors: The Gender Transcendent factor, which measures participants' beliefs about non-traditional gender roles for women, and the Gender-Linked factor, which measures participants' beliefs that specific social roles are to be fulfilled by individuals of a certain gender. The Gender Transcendent factor was shown to have strong factor loading, high face validity, and acceptable internal reliability ($\alpha = .65$) and the Gender-Linked factor, which were also shown to have strong factor loading, high face validity, and acceptable internal reliability ($\alpha = .77$; Baber & Tucker, 2006).

Career decision self-efficacy. The Career Decision Self-Efficacy – Short Form (CDSES-SF; Taylor, & Betz, 1983) is a 25-item measure of self-efficacy in career decision making. The measure utilizes a 5-point Likert scale that ranges from 1 (No confidence at all) to 5 (Complete confidence). Sample items include, "Determine the steps you need to take to successfully complete your chosen major", and "Choose a career that will fit your preferred lifestyle".

Data Analysis

Data was collected via the Qualtrics online survey platform and was entered and analyzed using the Statistical Package for Social Sciences 26.0 (SPSS). The data was then cleaned and descriptive analyses will be completed. A missing data analysis will be conducted via SPSS to determine if data is missing completely at random. Respondents who complete only demographic data and no other surveys will be deleted listwise, as well as participants who complete fewer than one complete measure. Correlational analyses will be conducted to explore the first three hypotheses and relationships among all variables. A series of moderation analyses,

via Hayes (2013) PROCESS macros for SPSS, will then be utilized to examine the moderating effects of video gaming on the relationships between self-efficacy and STEM motivations, self-efficacy and career interests, sex role beliefs and STEM motivations, and sex role beliefs and career interests.

Chapter 3

Results

Data Cleaning and Preparation

Prior to testing for significance of any of the proposed hypotheses data were cleaned, missing data was addressed, and assumptions for a general linear model were assessed. Little's Missing Completely at Random (MCAR) test was conducted to assess for the randomity of missing data. Results of Little's MCAR test determined that data was missing completely at random ($\chi^2[1258] = 1293.571$, $p > .05$). Missing data ranged from 0% on the video game play rate measure to 1.1% for the Science Motivation Questionnaire. Data that was missing was addressed using multiple imputation (MI). MI is the optimal solution for handling data that is missing completely at random as the process involves averaging the parameter estimates across multiple imputations of the data, ultimately resulting in the standard errors of the parameter estimates being determined by both the standard errors of the entirety of the dataset as well as the dispersion estimates across the entire data set (Schlomer et al., 2010). Five imputations were performed and analyses, with the exception of PROCESS, were conducted using pooled data.

Assessing for Parametric Assumptions

The predictor and moderating variables were both standardized to reduce problems with multicollinearity as both variables are continuous (Aiken & West, 1991; Frazier, Tx, & Barron, 2004). Preliminary exploratory analyses indicated that there were no issues with outliers as the

maximum Cook's Distance was found to be <1 and the calculated Centered Leverage Value (3p/n = .01) falls between our minimum and maximum values, suggesting no outliers among the data. Independence of errors assumption was met via an acceptable Durbin-Watson value (1.841). Preliminary analysis determined that assumptions regarding multicollinearity were met with a maximum variance inflation factor of 1.042. Analysis of scatterplots suggested that assumptions of linearity and homogeneity of variance were met as scatterplots did not produce any identifiable patterns in the output. Skewness values for all variables fell between an absolute value of 0 and 1. Kurtosis values for all variables, with the exception of self-efficacy, fell within an absolute value between 0 and 1. The kurtosis value for self-efficacy was 1.65, which despite being slightly leptokurtic, is well within acceptable limits (Mayers, 2013).

Correlations

Bivariate correlations were performed to test hypotheses 1, 2 and 3 (see Table 1). The first hypothesis predicted a significant positive association between lifetime gaming frequency (LGF) with STEM career interest (StCI) and STEM science motivation (StSM). Contrary to the prediction, both StCI and StSM produced small, non-significant, positive correlations near zero with LGF. The second hypothesis predicted a significant positive association between career decision self-efficacy (CDSE) and StSM and StCI, respectively. As predicted, CDSE had a significant small positive relationship with SM, however no significant relationship was evidenced between CDSE and StCI. The third hypothesis stated that a negative association would be observed in the relationship between adherence to traditional gender roles (GR) and StSM and StCI, respectively. Correlational analyses indicated a minimal negative correlation between GR and StSM, while a minimal positive correlation exists between GR and StCI. Notably, neither correlation between GR and StCI or StSM were found to be significant.

A secondary set of bivariate correlations (see Table 2) were conducted after splitting groups between those who indicated that they did play video games (N = 107) and those who indicated they did not play video games (N = 79), to assess for associations between variables among each group. Secondary analyses on those who indicated historical video game play reflected near congruent results as analysis on the entire population. A small, non-significant, positive association was still seen among the correlations for both StCI and StSM with LGF. The association between CDSE and StSM was again found to have a small, significant, positive relationship while no significant relationship was evidenced between CDSE and StCI. The relationship between GR among StSM and StCI were both non-significant, minimally positive correlations.

Comparison of Means Between Groups

A secondary analysis comparing means between groups were conducted to test specific associations between those who indicated historical frequency of video game play and those who did not. When segregated, 107 participants indicated that they engaged in at least some regular video game play while 79 participants indicated they had engaged in no video game play at all. Comparisons of means were conducted via t-test and produced statistically significant differences across all measures. Those who indicated a history of video game play endorsed small, significant elevation in StSM scores as compared to those who did not indicate a history of video game play (M_1 = 3.78, SD_1 = .80, M_2 = 3.62, SD_2 = .75, $p < .001$) and a small significant elevation in scores on the StCI scale (M_1 = 3.65, SD_1 = 1.04, M_2 = 3.52, SD_2 = 1.11, $p < .001$), suggesting that those who engage in video game play have higher levels of science motivation and STEM career interest than those who do not. Participants who indicated a history of video game play also endorsed a moderate, significant difference in scores on the GR

measure, reporting lower scores than those who reported no history of video game play (M_1 = *3.00* , SD_1 = 1.35, M_2 = 3.67, SD_2 = 1.52, $p < .001$), suggesting participants who played video games endorsed fewer traditional gendered expectations than those who did not. Participants who reported a history of video game play evidenced a small, significant difference, as compared to those who reported no history of video game play, on the CDSE measure (M_1 = 3.78, SD_1 = .70, M_2 = 3.94, SD_2 = .71, $p < .001$), reporting lower scores. Therefore, video gamers reported less career decision self-efficacy than non-gamers.

Moderation

Moderation results are presented in Tables 3 and 4. The fourth and fifth hypotheses were tested using Model 1 of the PROCESS macro introduced by Hayes (2013). For both analyses, 10,000 bootstrap resamples were used to produce 95% biased-corrected confidence intervals. Four models were tested to determine whether gaming frequency moderated the relationship between the predictor variables, gender roles and self-efficacy, and the criterion variables, science motivation and career interest. Three of the four models revealed no significant direct interactions or interaction effects between the predictor variable and criterion variable with gaming frequency serving as the moderating variable within the model. For the first model, designed to test the hypothesis that gaming frequency would moderate the relationship between GR and StSM such that LGF would attenuate the relationship between GR and StSM, the overall model was not significant (R^2 = .01, F (3,180) = .64, p = .59). No significant direct effect was observed between GR and StSM (r = .001, p = .99). No significant interaction was observed when the moderating variable was introduced (r = .10, p = .20) nor was there a significant interaction effect (r = .03, p =.66).

The second model was designed to test the hypothesis that gaming frequency would moderate the relationship between GR and StCI such that gaming frequency would attenuate the

relationship between GR and StCI. The overall model was not significant (R^2 = .01, F [3, 180] = .62, p = .61). No significant direct effect was found between GR and StCI(r = .06, p = .46); no significant effect was found between StCI and LGF (r = .09, p = .23); the interaction effect was found to be non-significant (r = .005, p = .95).

The third model was designed to test the hypothesis that gaming frequency would moderate the relationship between CDSE and StCI such that as LGF increased, the relationship between CDSE and StCI would strengthen. The overall model was not significant (R^2 = .03, F [3,180] = 1.84, p = .14). The direct effect between CDSE and StCI was also found to be not significant (r = .10, p = .71). No significant effect was found between StCI and the LGF (r = .10, p = .17). No significant interaction was found in this model (r = -.10, p = .12).

The fourth model was designed to test the hypothesis that gaming frequency would moderate the relationship between CDSE and StSM such that as LGF increased, the relationship between CDSE and science motivation would strengthen. The overall model was significant (R^2 = .13, F [3,180] = 8.91, p < .001). The direct effect between CDSE and StSM was significant (r = .35, p < .001) as was the effect between StSM and the LGF (r = .15, p < .05), suggesting that the interaction of both self-efficacy and video game play have a significant positive relationship with science motivation. The interaction, however, was not found to be significant (r = .01, p = .90), suggesting that video game play does not have a significant moderating effect on the relationship between CDSE and science motivation.

Chapter 4

Discussion

The purpose of this study was to explore whether engagement in video game play is related to STEM career interests among women. The first hypothesis was not supported as no significant association was indicated between lifetime gaming frequency and career interest or

science motivation. When comparing between gamers and non-gamers, however, significant mean differences were found between the groups as gamers indicated higher levels of science motivation and STEM career interests than non-gamers. The difference between these two groups suggests that video games do play a role in facilitating motivation to engage in scientific studies as well as maintain interest in STEM careers. These results also suggest support for Gottfredson's theory (1981) as some exposure to science and technology facilitated higher rates of interest in scientific fields than no exposure.

The second hypothesis was partially supported. Specifically, higher rates of career decision self-efficacy were associated with higher rates of STEM science motivation among participants. Career decision self-efficacy, however, was not associated with STEM career interest indicating those with higher levels of career decision self-efficacy were more likely to pursue scientific interests, such as learning software languages and engagement in advanced mathematics, chemistry, and physics, without necessarily pursuing scientific career interests. Exploratory analyses revealed non-gamers reported higher levels of career decision self-efficacy than gamers.

The third hypothesis was not supported as no association was present between gender roles and career interest or science motivation. Despite no significant correlations between gender roles and career interest or science motivation, respectively, comparisons of group means did produce significant differences between gamers and non-gamers. Those who engaged in video game play endorsed fewer traditional gendered expectations than those who did not.

The fourth and fifth hypotheses focused on the potential of gaming frequency to moderate the relationships between gender roles and self-efficacy among career interest and science motivation. The fourth hypothesis was not supported as gaming frequency was not

shown to moderate the relationship between gender roles and career interest or science motivation. The fifth hypothesis was not supported as gaming frequency was not shown to moderate the relationship between self-efficacy and career interest or science motivation.

Integration with Previous Research

The findings of this study align with patterns viewed in previous studies which evidenced significant relationships between playing video games and increased STEM science motivation and STEM career interests among girls and women (Falco & Summers, 2017; Giammarco et al., 2015). Lantz (2015) found that engagement in video game play created a greater level of comfort with technology and, qualitatively, gamers reported confidence in STEM-related courses; however, similar to the present study, a direct significant relationship between video game play, independently, and STEM academic interests was not apparent. The findings of the current study reflect those of Lantz's (2015), suggesting that, independently, video game engagement may have less of an effect on career interest or STEM motivation for women than other, more closely related factors, such as social engagement and self-efficacy (Bandura, 1994, Giammarco et al., 2014, Robnett & Leaper, 2013). However, given gamers reported higher science motivation and STEM career interest than non-gamers, it is likely that video games may help women foster interest in STEM academic areas and careers, though perhaps through avenues other than frequency of gaming. Notably, career decision self-efficacy scores were significantly higher among non-gamers as compared to gamers, challenging results from previous studies, such as Lantz (2015), which found gamers to have higher levels of STEM career interests than their non-gaming counterparts. The differences in career decision self-efficacy in the present study may indicate a higher focus on real-world career choices by non-gamers as they spend less time in a fictional world provided in video game play.

Parting from traditional gender role expectations by women who play video games is not without precedent (Millers & Summers, 2007), however the reasoning as to why remains elusive. Although the present study found group differences between female gamers and non-gamers, with gamers evidencing less obedience to traditional gender roles, Millers and Summers (2007) also found that girls who play video games often play as male protagonists which may obscure the boundaries of traditional gender roles. Engagement as a male character may serve as a bridge of sorts for girls and women to normalize traditionally masculine thought as they are guided through traditionally masculine narratives while playing video games. By playing through the perspective of a male character, female gamers are perhaps able to soften lines between the biological sex and/or gender differences between them and their character and incorporate the gender norms and expectations of their character in the fictional world in real-world settings. Further, as video game communities are dominated by male-identified gamers, female gamers may be socialized toward behavior more commonly expected of boys and men. The confounding of traditional gender roles may serve as a primary factor for the findings within the present study which evidenced female gamers to adhere less to traditional gender roles than non-gamers. With such findings, some support is given to the possibility that video games may be a practical tool in negating perceived gender bias in scientific fields for girls and women.

Implications for Future Research

Two questions that remain are 1) how to increase women's representation in high-paying STEM fields and 2) what role, if any, might video games play in establishing that goal. Self-efficacy has been established to have a direct impact on STEM career motivations for women, suggesting that, for the question of how to facilitate stronger representation of women in STEM career fields, focus should be placed on how to best build self-efficacy among girls and women.

Research efforts to gain practical understanding of how to minimize stereotype threat, provide curriculum that emphasizes constructive feedback, and facilitating supportive social constructs for girls and women may be more beneficial towards establishing self-efficacy than a standalone intervention.

The question of how best to utilize video game interventions is difficult to answer. Evidence suggests that video games alone are insufficient in promoting STEM interests (Lantz, 2015) however researching how they could be used as a tool in a more comprehensive curriculum may be beneficial for teaching and establishing skills that are correlated with STEM career fields. The use of video games to train skills is not uncommon as video games have been used to train surgeons to operate quicker with fewer mistakes, are regularly used to train military personnel and as previously mentioned, has been shown to train spatial reasoning skills (Derby, 2014; Feng, Spence, & Pratt, 2007; Rosser et al., 2007). Research directed at utilizing video games to improve skills that would supplement additional attempts to establish self-efficacy may be a more promising avenue in the exploration of video games and women's STEM engagement.

The present study evidenced significant group mean differences between gamers and non-gamers, suggesting that further research focused on the way video game play effects science motivation and career decision self-efficacy may be beneficial. Analyzing present and historical gaming habits of women who are already established in successful STEM careers may also be beneficial for identifying patterns for future applications. Future research may also investigate the relationship between women identified as gamers, their levels of self-efficacy, and the ways in which they identify with characters and stories in games to evaluate whether video game characters can supplement self-efficacy through modeling.

Implications for Practice

Findings from this study indicate that as an independent intervention, video games may not be particularly efficient, however previous research has established the utility of video game interventions to improve and maintain skill sets that are commonly found among STEM careers. (Blickenstaff, 2005; Bonner & Dorneich, 2016). Incorporating video game play with additional elements, such as socialization via multiplayer gaming, may also be beneficial for women as previous research has indicated that social support among same-sex peers is a strong predictor of success in STEM academic (Frostling-Henningson, 2009; Good, 2019; Friffiths et al., 2003).

Limitations

Limitations were present to the applications and inferences that can be made from the findings of this study. First, the majority of participants in this study were undergraduate women from one U.S.-based institution who were primarily majoring in health sciences. Future studies would benefit from collecting information on a more diverse sample of STEM associated majors, including a balanced sample consisting of engineering, physical science and health science majors to provide a more comprehensive representation of STEM career paths. Secondly, utilizing correlational data for three of the five hypotheses in this study means that causation cannot be inferred. Additionally, this study required participants to recall historical video game patterns that were subject to some inaccuracy. Future studies would benefit from a more controlled approach to more accurately measure video game play to produce results that are more easily replicable and from which inferences can be made. This study also utilized survey measures that may have been too broad in their scope and may have benefitted from survey measures customized to measure the constructs intended.

Conclusion

This study set out to discover whether a popular form of entertainment, video gaming, could be utilized to address concerns of gender occupational inequality in a economically prosperous group of industries. A connection between CDSE and science motivation was discovered which supports previous research and suggests that when women are put into positions where they are challenged, supported, and can find some success, the ability to persevere in these pursuits is greatly increased. Gender roles were not found to have any effect on STEM motivation nor career interest. Lifetime frequency of video game play was also not found to be reliable predictors of women's career and academic interests. The minimal effect of video games as a moderator was also true when self-efficacy served as the predictor variable, with video games yielding no statistically significant effect on either STEM motivation or career interest. Further research is needed to identify and further explore various methods in which utilization of video game interventions may be effective to promote STEM engagement by women.

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APPENDIX A: DEMOGRAPHIC QUESTIONNAIRE

The questions on this page request personal information used to compare different groups of people. Please describe yourself honestly by filling in the blanks, or checking your response.

1. Sex Assigned at Birth (please choose one)
   _____Male
   _____Female

2. How do you currently identify your gender?
   _____Male
   _____Female
   _____Transgender/Trans-man/Trans-woman
   _____Intersex
   _____Queer/Gender Non-Conforming
   _____Other; Please identify_____

3. Age (in years):_____

4. Race/ethnicity (please mark the category that best describes your race/ethnicity):
   ___White/European American
   ___Hispanic/Latino(a)
   ___Black/African/African American
   ___Native American or Alaskan Native
   ___Asian/Asian American/Pacific Islander
   ___Bi- or Multiracial/Ethnic (Specify all): _____
   Other; Please specify: _____

5. Sexual Orientation:
   ___Gay/lesbian
   ___Straight/heterosexual
   ___Bisexual
   ___Pansexual
   ___Other (please specify):_____

6. Do you consider yourself financially:
   a. ___Dependent on family (I depend on financial support from parents/family)
      a. If you consider yourself to be financially **dependent,** please select the range that best describes your family's annual income before taxes. If you fall in

between categories (i.e., $23,500) please determine if your financial situation would be best described by rounding up or down:

___$19,000 and below
___$20,000-$23,000
___$24,000-$32,000
___$33,000-$60,000
___$61,000-$100,000
___$101,000-$150,000
___$151,000 and above

b. Independent from family (I do not depend on financial support from parents/family)
    a. If you consider yourself to be financially **independent,** please select the range that best describes your annual income before taxes. If you fall in between categories (i.e., $23,500) please determine if your financial situation would be best described by rounding up or down:

___$19,000 and below
___$20,000-$23,000
___$24,000-$32,000
___$33,000-$60,000
___$61,000-$100,000
___$101,000-$150,000
___$151,000 and above

7. Have you been diagnosed with any disability or impairment?

___Yes

___No

___I prefer not to answer

If yes, which of the following have been diagnosed?

___A sensory impairment

___A mobility impairment

___A learning disability

___A mental health disorder

___A disability or impairment not listed above

8. What is your major? _____

9. What is your overall GPA?

   4.0 to 3.5 _____
   3.49 to 3.0 _____
   2.00 to 2.5 _____
   2.49 to 2.0 _____
   1.9 to 1.5 _____
   1.49 to 1.0 _____
   Below 1.0 _____

10. What is your student classification status?

    First year: _____

    Second year: _____

    Third year: _____

    Fourth year: _____

    Fifth year: _____

    Master's student: _

    Doctoral student: _____

11. Do you play video games?

    YES___ NO___

12. At what age did you start playing video games? _____

13. If "yes", please rank which platforms you play video games on with 1 indicating the most frequently used, 2 representing the second most frequently used, 3 representing the third most frequently used, etc.

    Playstation _____ Xbox _____ Personal Computer (PC) _____ Phone _____

    Nintendo Switch_____Classic Consoles (NES/SNES/Sega Gensis/Dreamcast) _____

    Nintendo 3DS_____Other (Please specify) _____

14. What video game genres do you play most frequently? Please indicate with 1 indicating the most frequently played, 2 indicting the second most frequently played, 3 representing the third most frequently played, etc.

Action (ex: Uncharted, Final Fantasy, Super Smash Brothers) _____

Adventure (ex: Witcher, Super Mario, Legend of Zelda) _____

Driving/Racing (ex: Rocket League, Forza Motorsports, Need for Speed) _____

Endless Runners (ex: Temple Run, Subway Surfers, Canabalt) _____

First Person Shooters (ex: Call of Duty, Halo, Doom) _____

Massive Multiplayer Online (ex: World of Warcraft, EVE Online, Tera) _____

Puzzle (ex: Candy Crush, Minecraft, Portal) _____

Role Playing Games (ex: Skyrim, Fallout, Dragon's Age) _____

Sports (ex: Madden, NBA2K, FIFA) _____

Strategy (ex: Civilization, The Sims, Starcraft) _____

Other (Please specify) _____

15. Do you play video games online?

YES_____ NO_____

16. If yes, who do you primarily play video games online with?

Friends (from school/work/etc.) _____ Friends (Exclusively online) _____

Family _____ Random Players_____

17. Thinking about the past 30 days, on average, how many days each week did you play video games? (Check the box that applies)

1	2	3	4	5	6	7

18. Over the course of your lifetime, on average, how many days each week have you played video games? (Check the box that applies)

1	2	3	4	5	6	7

19. Thinking about the past 30 days, on average, how long do you play video games each time you play? (Please check the box that applies)

0 – 30 minutes	
30 minutes – 1 hour	
1– 2 hours	
2 – 3 hours	
3- 4 hours	
4 – 5 hours	
5+ hours	

20. Historically, over your lifetime, on average, how long have you played video games each time you play? (Please check the box that applies)

0 – 30 minutes	
30 minutes – 1 hour	
1– 2 hours	
2 – 3 hours	
3- 4 hours	
4 – 5 hours	
5+ hours	

21. Are there any video game characters that you identify with?

YES_____ NO____

22. If so, who? (Please name the character and the game in which they are found)

APPENDIX B: SCIENCE MOTIVATION QUESTIONNAIRE II

In order to better understand what you think and how you feel about your science courses, please respond to each of the following statements from the perspective of "When I am in a science course…"

1. The science I learn is relevant to my life.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

2. I like to do better than other students on science tests.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

3. Learning science is interesting.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

4. Getting a good science grade is important to me.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

5. I put enough effort into learning science.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

6. I use strategies to learn science well.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

7. Learning science will help me get a good job.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

8. It is important that I get an "A" in science.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

9. I am confident I will do well on science tests.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

10. Knowing science will give me a career advantage.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

11. I spend a lot of time learning science.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

12. Learning science makes my life more meaningful.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

13. Understanding science will benefit me in my career.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

14. I am confident I will do well on science labs and projects.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

15. I believe I can master science knowledge and skills.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

16. I prepare well for science tests and labs.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

17. I am curious about discoveries in science.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

18. I believe I can earn a grade of “A” in science.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

19. I enjoy learning science.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

20. I think about the grade I will get in science.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

21. I am sure I can understand science.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

22. I study hard to learn science.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

23. My career will involve science.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

24. Scoring high on science tests and labs matters to me.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

25. I will use science problem-solving skills in my career.

0	1	2	3	4
Never	Rarely	Sometimes	Often	Always

APPENDIX C: CAREER INTEREST QUESTIONNAIRE

1. I would like to have a career in science.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

2. I would enjoy a career in science.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

3. I will graduate with a college degree in a major area needed for a career in science.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

4. My family has encouraged me to study science.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

5. I will make it into a good college and major in an area needed for a career in science.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

6. I will get a job in a science-related area.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

7. My family is interested in the science courses I take.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

8. I will have a successful professional career and make substantial scientific contributions.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

9. Some day when I tell others about my career, they will respect me for doing scientific work.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

10. A career in science would enable me to work with others in meaningful ways.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

11. Scientists make a meaningful difference in the world.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

12. Having a career in science would be challenging.

1	2	3	4	5
Strongly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Strongly Agree

APPENDIX D: SOCIAL ROLES QUESTIONNAIRE

For the following thirteen statements, please indicate what percentage you agree or disagree with the statement by using the following indication:

Strongly Disagree										Strongly Agree
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

1. People can be both aggressive and nurturing regardless of sex

Percentage:_____

2. People should be treated the same regardless of their sex.

Percentage:_____

3. The freedom that children are given should be determined by their age and maturity level and not by their sex.

Percentage:_____

4. Tasks around the house should not be assigned by sex.

Percentage:_____

5. We should stop thinking about whether people are male or female and focus on other characteristics.

Percentage:_____

6. A father's major responsibility is to provide finically for his children.

Percentage:_____

7. Men are more sexual than women.

Percentage:_____

8. Some types of work are just not appropriate for women.

    Percentage:_____

9. Mothers should make most decisions about how children are brought up.

    Percentage:_____

10. Mothers should only work if necessary.

    Percentage:_____

11. Girls should be protected and watched over more than boys.

    Percentage:_____

12. Only some types of work are appropriate for both men and women.

    Percentage:_____

13. For many important jobs, it is easier to choose men instead of women.

    Percentage:_____

APPENDIX E: CAREER DECISION SELF-EFFICACY SCALE – SHORT FORM

How much confidence to you have that you could:

1. Find information in the library about occupations you are interested in?

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

2. Select one major from a list of potential majors you are considering.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

3. Make a plan of your goals for the next five years

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

4. Determine the steps to take if you are having academic trouble with an aspect of your chosen major.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

5. Accurately assess your abilities.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

6. Select one occupation from a list of potential occupations you are considering.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

7. Determine the steps you need to take to successfully complete your chosen major.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

8. Persistently work at your major or career goal even when you get frustrated.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

9. Determine what your ideal job would be.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

10. Find out the employment trends for an occupation over the next ten years.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

11. Choose a career that will fit your preferred lifestyle.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

12. Prepare a good resume.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

13. Change majors if you did not like your first choice.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

14. Decide what you value most in an occupation.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

15. Find out about the average yearly earnings of people in an occupation.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

16. Make a career decision and then not worry about whether it was right or wrong.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

17. Change occupations if you are not satisfied with the one you enter.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

18. Figure out what you are and are not ready to sacrifice to achieve your career goals.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

19. Talk with a person already employed in the field you are interested in.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

20. Choose a major or career that will fit your interests.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

21. Identify employers, forms, institutions relevant to your career possibilities.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

22. Define the type of lifestyle you would like to live.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

23. Find information about graduate or professional schools.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

24. Successfully manage the job interview process.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

25. Identify some reasonable major or career alternatives if you are unable to get your first choice.

1	2	3	4	5
No confidence at all	Very little confidence	Moderate confidence	Much confidence	Complete confidence

APPENDIX F: TABLES

Table1

Bivariate Correlations, Means, and Standard Deviations

Correlations

Measure	1	2	3	4	5
1. Gaming Days per Week	--	.91	.08	-.12	-.15
2. Science Motivation	--	--	.66**	-.01	.33**
3. Career Interest	--	--	--	.04	.77
4. Gender Roles	--	--	--	--	-.10
5. Self-Efficacy	--	--	--	--	--
Possible Range	1-11		1-7	1-7	1-7
M	3.22	3.71	3.60	3.28	3.8
SD	2..37	.78	1.07	1.46	.71

Note. ** $p < .01$. * $p < .05$.

Table 2

Bivariate Correlations, Means, and Standard Deviations for Gamers Only

Correlations

Measure	1	2	3	4	5
1. Gaming Days per Week	--	.02	.07	.15	-.13
2. Science Motivation	--	--	.68**	.73	.411**
3. Career Interest	--	--	--	.1	.05
4. Gender Roles	--	--	--	--	-.14
5. Self-Efficacy	--	--	--	--	--
Possible Range	1-11		1-7	1-7	1-7
M	4.86	3.78	3.65	3.00	3.79
SD	1.86	.80	1.04	1.35	.70

Note. ** $p < .01$. * $p < .05$.

Table 3

Tests of Gaming Frequency as Moderator of Relations for Gender Roles, Career Interest and Science Motivation

Testing Steps in Moderation Models	*B*	*SE*	*Model*	95% CI
Career Interest				
Gender Role (X)	.06	.07	$R^2 = .01$, F (3,180) = .62	[-.09, .20]
Gaming Frequency (M)	.09	.07		[-.06, .24]
Gender Role * Gaming Frequency (X*M)	.00	.07	$\Delta R^2 = 0.0$, F (1,180) = .00	[-.13, .14]
Science Motivation				
Gender Role (X)	.00	.07	$R^2 = .01$, F (3,180) = .64	[-.15, .14]
Gaming Frequency (M)	.10	.07		[-.05, .24]
Gender Role * Gaming Frequency (X*M)	.03	.07	$\Delta R^2 = .00$, F (1,180) = .19	[-.10, .16]

Note: CI = confidence interval. * $p < .05$

Table 4

Tests of Gaming Frequency as Moderator of Relations for Career Decision Self-Efficacy, Career Interest and Science Motivation

Testing Steps in Moderation Models	*B*	*SE*	*Model*	95% CI
Career Interest				
Self-Efficacy (X)	.10	.07	R^2 = .03, *F* (3,180) = 1.84	[-.04, .25]
Gaming Frequency (M)	.10	.07		[-.05, .25]
Self-Efficacy * Gaming Frequency (X*M)	-.10	.07	ΔR^2 = .01, *F* (1,180) = 2.41	[-.23, .03]
Science Motivation				
Self-Efficacy (X)	.35*	.07	R^2 = .13, *F* (3,180) = 8.91	[.21, .49]
Gaming Frequency (M)	.15**	.07		[.01, .29]
Self-Efficacy * Gaming Frequency (X*M)	.01	.06	ΔR^2 = .00, *F* (1,180) = .90	[-.12, .13]

Note: CI = confidence interval. * $p < .05$, ** $p < .001$