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From screen to green: The effect of screen time and setting on pre-adolescent children's executive function skills.

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From screen to green: The effect of screen time and setting on pre-adolescent children's executive function skills.

A dissertation submitted in partial satisfaction

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in Special Education

by

Debra Christine Garcia

2015

ABSTRACT OF THE DISSERTATION

From screen to green: The effect of screen time and setting

on pre-adolescent children's executive function skills.

by

Debra Christine Garcia

Doctor of Philosophy in Special Education

University of California, Los Angeles, 2015

Professor Jeffrey J. Wood, Co-chair

Professor Patricia M. Greenfield, Co-chair

According to Greenfield's Theory of Social Change and Human Development (2009), ecological changes lead to shifts in human development. With technological resources available to early-adolescent youth, it is expected that "digital-natives" will demonstrate developmental shift patterns relating to cognitive skills of attention. This study further explores the impact of Attention Restoration Theory (ART) upon selective attention in pre-adolescent children. Attention skills of fifth-grade digital natives were assessed using the Test of Everyday Attention for Children in two environmental conditions – natural settings and urban settings. A media survey was administered to assess the effect of digital media frequency use upon attention. Fifth grade students assessed in a natural environment had better attention scores than their peers assessed in an urban classroom setting. In addition, gifted children in natural settings out-performed their gifted peers assessed in urban settings. A shift in attention skills in gifted and non-gifted students due to digital media resources did not occur. Results have implications for classroom settings that enhance attention and culture based behaviors of digital media use.

Keywords: digital media, social change, executive functions, attention, nature, urban setting

The dissertation of Debra Christine Garcia is approved.

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VITA/BIOGRAPHICAL SKETCH

Debra Christine Garcia received the Bachelor of Arts in English Literature and the Bachelor of Arts in Speech Communications from California State University, Los Angeles in 1993. She earned the Master of Arts in Developmental Psychology from California State University, Los Angeles in 1996. She has presented research in the domain of absenteeism and psychopathology at various conferences and will continue presenting and publishing research evaluating executive function skills of gifted and non-gifted students in various education settings. Debra Christine Garcia will continue her faculty position at California State University, Los Angeles in both the Psychology Department and The Charter College of Education.

From Screen to Green: The Effect of Screen Time and Setting on Pre-Adolescent Children's Executive Function Skills

Introduction

With our changing societal landscape of widespread technological use, changes in developmental patterns are to be expected, particularly with "digital natives" – people who have been exposed to technology since birth. The "Net Generation", a term coined by Tapscot (1997), are those born after 1985 at the early stages of mass technology. This generation has experienced revolutionary societal change and is considered the first global generation (Subrahmanyan & Smahel, 2012; Global WorkPlace Innovation [GWI], 2011).

Also known as the "Millennial Generation", digital natives have been scrutinized by befuddled "Baby Boomers" who grew up during the days of limited household technology, where the primary sources of digital exposure was television, radio and perhaps Pong. Much of the bewilderment of digital immigrants – those born before the widespread adoption of digital technology (Prensky, 2001)—comes in the form of questioning how digital technology may impact the social, cognitive, sexual and identity development as well as cultural values of the individual and society at large.

Evolutionary and socio-cultural theorists as well as developmental psychologists have recognized for decades that grand and extensive ecological changes will impact societal and developmental patterns of human growth and maturation in multiple domains (Meyers, 2014, Greenfield, 2009; Manago & Greenfield, 2011). One such domain of particular interest is that of abstract cognition (Greenfield, 2009). The potential developmental shifts in executive functions (EF) to digital natives may have pervasive and "mind altering" affects on children's learning and thinking that researchers have yet to unearth. EF are cognitive skills that include abstract

concepts such as "planning, organizing and information manipulation (Barkley, 2012). These skills are particularly necessary to attend to information, master tasks, learn new information, regulate behavior and control inhibitions (Wasserstein & Denckla, 2009).

Since the majority of media consumption is now screen based (Pham, 2012) understanding and revealing how digital media "screen time" (amount of exposure to digital screens) may impact cognitive processes is of value in many societal domains but appears to be most essential to education systems. Education systems are charged with the daunting task of the transmission of knowledge to children and youth so that learning and eventual advancement of our society will transpire. Thus, recognition of how EF (a critical ingredient of cognition and learning) may be influenced by digital media screen time is a topic worthy of exploring for the benefit of our societal development.

Purpose of the Study

The indiscernible effects of digital media upon learning are unclear due to the lack of research in the area of attention, learning, and screen-time use in children and adolescents in a society embedded with technology. Modern research on the use of digital media sources and children has been generally focused on children with attention deficit hyperactivity disorder (AD/HD) and is limited in scope. Much of this research focuses on technologically based therapeutic interventions for children with significant attentional impairments (e.g. AD/HD, behavioral disorders) using computer-based video games and neuro-feedback (Shaw & Lewis, 2005; Shaw, Grayson & Lewis; Wilkinson, Ang & Goh, 2008; Bink, van Nieuwenhuizen, Popma, Bongers, & van Boxtel, 2014; Shalev, Tsal, & Mevorach, 2007; Solomonidou, Garagouni-Areou, & Zafiropoulou, 2004).

Thus, this study aims to explore the impact of the frequency and type of screen-time use on the EF skills of typically developing children—both gifted and non-gifted—in two learning environments (outdoor education camp and urban school). With the pervasive use of technology in the United States, this study is intended to identify the impact of screen time usage upon pre-adolescent children's selective attention in two different settings.

Definition of key terms. *Executive functions,* also known as cognitive control and supervisory attentional system, is an umbrella term for the management of cognitive processes, including working memory, reasoning, task flexibility, attention, problem solving, planning and execution. An EF process of interest in this present study is *attention. Attention* is a behavioral and cognitive process of selectively concentrating on a discrete aspect of information, whether deemed subjective or objective, while ignoring other perceivable information. *Giftedness* is an intellectual ability significantly higher than average typically referred to a characteristic of children

Digital native is a person born or brought up during the age of digital technology and therefore at an early age familiar with computers and the Internet, as are the participants in the present study. *Multi-media use* is the combined exposure and use of several media sources at the same time while *Screen-time* is the time spent using a device such as a computer, television, cell phone or games console.

Literature Review

Digital Natives as Media Consumers

Exposed to technology at birth, digital natives are quite savvy in digital media utility that is readily accessible. With access to an array of technology in the home such as smartphones, tablets, laptops and e-readers, digital media is frequently integrated into the waking lives of

infants, children and youth. Access to technology cuts across gender and ethnicity more so in this decade than ever before (Media Literacy Clearinghouse, 2013) with nearly 40% of infants using mobile devices with efficiency (Common Sense Media, 2011). Children and youth of today's technological society engage in copious amounts of digital media usage on a daily basis (Subramanyan & Smahel, 2012).

Digital natives text, instant message, video message, surf the internet, download music, Netflix, and YouTube. They use social media sites such as Snap Chat, Instagram, FaceBook and Twitter. All this screen time equates to media consumption of nearly 35 hours a week (Viacom, 2013). Television viewing is up 12% in the past decade and video games permeate the lives of digital natives for 27% of their day. In fact, ninety-six percent of children and youth today say they would rather use their computers and other hand-held devices for gaming purposes than for homework or internet research (Viacom, 2013).

Adolescent on-line time is typically spent on social media sites engaged in interpersonal communication or downloading music content. Current statistics indicate that 81% of youth ages 13-18 years engage in social media (Media Literacy Clearinghouse, 2013) with much of the on-line dialogue consisting of teen issues relating to "gender and racial identity, sexual development, and romantic partners" (Greenfield, Gross, Subrahmanyam, K., Suzuki, L. K., & Tynes, 2006). Teens tend to make the on-line world their milieu to foster relationships, learn and play (Spero & Stone, 2004).

Television viewing is still the most widely utilized form of media consumption in the United States and comprises nearly seven full days (approximately 145 hours) of child and youth waking hours per month. Children ages 0 – 8 years watch just under 2 full hours of television per day with nearly half of these children having a television in their own bedrooms (Common Sense

Media, 2013). A significant portion of children and youth engaged in television viewing do so with some other form of digital technology by their side (KPMG International, 2013) and not surprisingly, one-third of the nation's "tweets" reflect matters relating to television content (Nielson, 2012). This multi-screen usage marks a shift in screen time behavior of digital native children and youth.

Having a personal cell phone seems to be a rite of passage beginning in the third-grade, with over 20% of nine-year olds report getting their 1st cell phone." (Pew Research Center, 2014). By middle-school, youth have had up to 3 phones with nearly 85% of them report having their own cell phones (Englander, 2011). With cell phone access, comes text messaging. According to recent research conducted by Pew Internet & American Life Project (2012), texting is the ultimate social tool for children and youth with 65% texting on a daily basis. Digital natives aged 13-17 years exchange nearly 3,500 messages per month with females texting slightly more often than males.

Gender differences and media use. In spite of prevailing anecdotal assumptions that males have higher media consumption than girls, research on gender and media use over the past decade has shown that both sexes engage in similar amounts of screen times (McCauley Ohannessian, 2009; Knox, Zusman, White & Haskins, 2009). Research on 261 male and female adolescents found the two genders engage in screen time at relatively same rates (Gross, 2004) and a longitudinal study with 328 teens further found equivalent amounts of media usage (McCauley Ohannessian, 2009).

Although it appears both boys and girls consume media at approximately the same rates, research indicates gender variations in use of digital media sources (Gross, 2004; McCauley Ohannessian, 2009; Pew Research Center, 2013) and parental restrictions (Van den Bulck & Van

den Bergh, 2010). Gender differences in media uses by several authors conclude that boys spend more time playing video games while girls spend more time accessing social media sources (McCauley Ohannessian, 2009; Pew Research Center, 2013; Zorilla, 2011).

Another interesting variation between genders is the difference of parental restrictions on media sources by gender. Parents tend to monitor and control media use of their daughters more frequently than their sons (Van den Bulck & Van den Bergh, 2010). This variation is likely due to concerns relating to sexual content and body image (Buckingham & Bragg, 2004; McCabe & Ricciardelli, 2001; Dohnt & Tiggemann, 2006). In spite of higher levels of parental restrictions upon daughters, female girls and teens typically navigate these controls through "media displacement" – the movement from a restricted media source to a non-restricted media source that offers the same on-line opportunity (Van den Bulck & Van den Bergh, 2010).

Most digital immigrant parents in our society question the access and overwhelming consumption of digital media in the lives of their children. Parents will frequently assert boundaries and "articulate authority" concerning the digital media use of their children (Clark, 2009). Several organizations and agencies such as Common Sense Media, Edutopia and Parent's Television Council provide facts, statistics and reports on media consumption hoping to increase parental knowledge on the subject. Frequently, the topics presented reflect how the "collision of digital and live culture" signals issues of power, struggle for autonomy, and the desire for freedom by youth within the domain of digital media (Richardson, 2014).

Despite widespread agreement that digital media are transforming how young people learn, communicate and engage in social justice in novel ways (Ferguson, 2009; Tetloff, Hitchcock, Battista & Lowrey, 2014), the negative reflection of digital natives as media consumers continues to exist. Many informal reports, such as news stories and radio

commentary, explicate a host of negative outcomes of digital natives, such as that they are unread, poor communicators, socially inept, unproductive, narcissistic and tend to disregard the needs of others (Davis, 2013; Coyne, Padilla-Walker, Howard, 2013; Viacom, 2013). This framework continues to exist in spite of the research that provides evidence that digital media use supports identity development, gender identity development and is a positive force in the development of youth leadership and community engagement (Greenfield et al., 2006; Ferguson, 2009).

Why do digital natives consume and devour media sources with intense cravings that keep them actively engaged countless hours per day? According to Ahn (2014), technology likely offers a resource that activates already existing human desires and needs. As social beings, we seek contact with others to unpackage the details of our daily lives, disclose personal information and create social circles based on familiarity, proximity and interests (Cavanauh-Blanchard & Fields, 2014). Digital media resources permit social connections in virtual settings where social media, chat rooms, and instant messaging resources are readily accessible (Ahn, 2014).

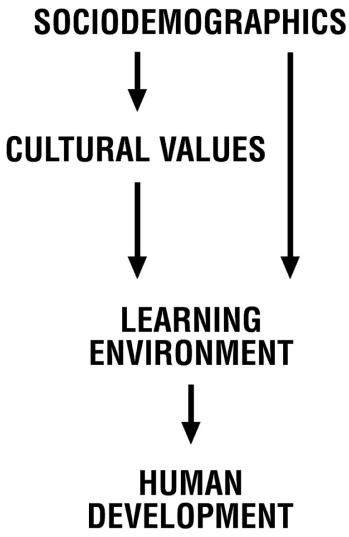
As a powerful medium inserted into the daily lives of digital natives, the force of technology has shifted our societal landscape, which will continue to impact a multitude of developmental domains in children and youth, particularly social and cognitive development.

Theoretical Perspective

According to Greenfield (2009), digital media is a critical component of informal learning environments. Exposure to television, video games, Internet and smart phones has developed a generation of learners with sophisticated visual intelligence beyond that of learners from prior generations (Greenfield, 2009). Evidence of the savvy visual intelligence of digital

natives is based on studies identifying the global rise of IQ scores (which measure visual intelligence) over the past one hundred years and across generations (Greenfield, 2009).

The theory behind Greenfield's perspective is founded in her Theory of Social Change and Development:



This theory postulates that changing socio-demographic landscapes, such as mass saturation of digital technology, changes both "cultural values and learning environments" which leads to developmental transformations in cognition across generations. This theory not only describes the ecological changes and their impact on development, but also predicts the alterations in developmental trajectories based on changing cultural and learning environments (Greenfield, 2009). As the purpose of this study is to explore the cognitive shifts in alignment with widespread digital media consumption, a detailed description of alterations in cognitive development in conjunction with Greenfield's theoretical model will be described.

Learning environments and cognition. Individuals who are adapting to changing socio-demographics, cultural values and learning environments will experience shifts in their cognitive development (Greenfield, 2003; 2015). Based on four decades of research conducted on a rural Mayan culture in Chiapas, Mexico, Greenfield, Maynard and Childs (2003) found that

Zinacantec Mayans shifted from subsistence to commerce, which enacted learning environment changes that affected cognitive development. Data collected across three-generations between 1969 and 2012 demonstrated that generational shifts in cognition went from detail orientation to a more abstract style of visual representation. Zinacantec children and youth adapted to a "more commercial and technological family environment" which led to superior visual intelligence compared to previous generations (Greenfield et.al., 2003). According to Greenfield et. al., these cognitive shifts are linked to ecological changes. Specifically, the "historical variability" that occurs across generations leads to the alteration of "child and adolescent cognition."

Digital media - social change and human development. As widespread technological use has changed the landscape of our society, the obvious *socio-demographic* change in American culture is the burgeoning digital sources of information and communication technology. With expansion at a rate almost too difficult to measure, technology has ubiquitously woven itself into the everyday lives of digital natives (Vodanovich, Sundara & Myers, 2010). It is embedded into our cultural values and is the catalyst for innovation, learning, thinking, and language development (George, Dumenco, Dollase, Taylor, Wald & Reis, 2013; Greenfield, 2009, 2013; Hong, 2010). Education systems are increasingly incorporating technology in the classroom as tool for learning support. Research on the use of technology in medical school has demonstrated that students who use technological resources to review material have higher levels of comprehension as assessed by test scores (George et al., 2013). Other researchers in K-12 domains have evaluated screen-based learning programs in the classroom. Teachers report that students who use technology in the classroom attend to lessons longer and have improved test scores (Hong, 2010).

Aside from educational systems, digital media sources have changed our cultural values

in just about every other domain which we access as a culture – including information access, interpersonal communication, transportation systems, medical interventions, criminal justice, workforce platforms and even sports strategies to name a few (Vodanovich, Sundara & Myers, 2010; McGillivray, 2014; Subramanyan & Smahel, 2012; Troshynski, 2012; Lumas, 2006; George, Dumenco, Dollase, Taylor, Wald & Reis, 2013; Kenan-Smalls, 2011).

Digital media embedded in our American culture have changed the way we communicate (Uhls et al., 2013; Vodanovich et al., 2010) and tend to be the preference for interpersonal communication (Subramanyan & Smahel, 2012). In addition, they have changed the way we interface in the workforce. American workers are now more involved in "telework" and off-site locations with communication and productivity that reaches the global community (Hoyer & Roodin, 2012; Kenan-Smalls, 2011).

How Americans move is another facet that demonstrates how technology is changing our cultural system. Transportation systems are incorporating technology by utilizing "trace-movement detection" to maintain safety in public transportation systems (Lumas, 2006) while "alternative transportation technologies" such as automated transport services, are being built to alleviate the stress on mass transit and ecological systems (Adams, Andrews-Cramer, Frommer, Simmons & Keasling, 2008).

Digital media and learning environments. In accordance with the Theory of Social Change and Human Development, the socio-demographic impact of digital media upon cultural values is expected to alter learning environments. Several researchers have evaluated the expansive digital media landscape that embeds our informal and formal learning environments in the United States (George et al., 2013; Wise, Greenwood & Davis, 2011; Nuttall, Edwards, Lee, Mantilla & Wood, 2013; Hong, 2010).

Formal learning environments are integrating technology in the classroom as teaching tools for academic achievement (Wise et. al., 2011; Anderson, Anderson, Davis, Linnell, Prince & Razmov, 2007). For example, students are developing "active learning" skills, such as real time feedback of technology based group discussions, as well as the ability to collaborate on academic projects beyond the classroom through student interactions via technology (Anderson et. al, 2007; Beldarrain, 2006). Much of the teacher training research on technology in the classroom incorporates pedagogical practices that emphasize teacher attitudes on technology, teacher selection practices and technology based training programs. Thus, current research and practice is fueling a new generation of teachers with the knowledge of "example based" collaborative instruction with technology (Bitner & Bitner, 2002; Vannatta & Nancy, 2004; Anderson et. al., 2007).

Digital media at school, home, in the car or while on a walk provides new digital contexts for knowledge development (Buckley, 2013). Based on the pervasive use of technology in formal and informal learning environments, there is widespread agreement that digital media are transforming how digital natives learn and communicate (Buckley, 2013).

According to Maynard, Greenfield and Childs (2015), "development of commerce and the expansion of formal schooling" play a vital role of the generational increases in cognitive performance in a Maya community in Chiapas, Mexico. Thorough investigation across four decades of the Nabenchauk culture found that sociodemographic changes tend to drive cognitive development toward abstract thinking (Maynard et. al., 2015). Based on the Theory of Social Change and Development (Greenfield, 2009), it appears the rapid changes in technology occurring within the United States will move child and adolescent cognition much like that seen within Nabenchauk culture of Chiapas, Mexico.

With the advent of easily accessible technological resources available to digital natives, it is expected that cognitive shifts of attention based skills of executive functions may present themselves in children and youth exposed to the massive and extensive digital media resources embedded in our cultural system.

Executive Functions

As a cognitive process, shifts in how digital natives will manage sets of mental abilities relating to executive functions will likely be seen given the socio-demographic, cultural value and learning environment changes that have occurred. Executive function is a term applied to the management and control of cognitive processes in the brain such as working memory, reasoning, task flexibility, problem solving, sequencing, planning, attention, organization and execution (Duncan, Emslie, Williams, Johnson, & Freer, 1996; Hester, Lubman, & Yucel, 2010; National Center for Learning Disabilities [NCLD], 2013). These sets of mental processes help people connect past, present and possible future actions to perform cognitive activities and engage in complex behaviors (Hester, Lubman, & Yucel, 2010; NCLD, 2013). A critical component of EF is attention to goal-directed behavior, which allows for achievement and task performance (Kowalczyk, 2012).

Attention - cool EF. Cognitive neuroscientists have made distinctions between two types of EF based on neural pathway activation. "Hot" aspects of EF are associated with the ventral and medial regions of the pre-frontal cortex (PFC). EF functions related to social decision-making and emotional responses are observed during the activation of this pathway (Bechara, Damasio, Damasio & Anderson, 1994) and are considered hot EF. Research by Prencipe, Kesek, Cohen, Lamm, Lewis, & Zelazo (2011) demonstrates that the development of hot EF is a gradual and slow process that continues to develop throughout late adolescence.

In contrast, when the dorsolateral region of the pre-frontal cortex (PFC) is activated, the "cool" aspects of EF such as attention, working memory, planning and inhibitory control are executed (Zelazo & Müller, 2002; Zelazo, Qu, & Müller, 2005; Hedden & Gabrieli, 2010; Weber, 2014). Based on cross-sectional design research, cool EF skills appear to develop at a fast rate and are efficient during late childhood in typically developing children (Prencipe et. al., 2011).

Since digital natives are actively engaged and attending to digital media sources around 35 hours per week (Common Sense Media, 2012), cool EF are of particular interest in relation to Greenfield's Theory of Social Change and Human Development. In fact, emerging evidence denotes that cool EF is incredibly malleable, particularly in children (Zelazo & Carlson, 2012) and still in the flux of development throughout adolescence (Prencipe et. al., 2011). Thus, mass digital media exposure and high screen time could lead to alterations in EF skills. One EF skill of particular interest to researchers, educators and parents in relation to the consumption of copious amounts of digital media is selective attention. A comprehensive review of attention skills in relation to digital media sources is presented to further our understanding of the changes in cognition of digital natives based on the technological shifts in their daily environments.

Attention sub-types. Attention is a "cool" EF skill that emerges in an array of complex constructs with differentiated manifestations. There are several sub-types of attention that must be considered when evaluating the impact of digital technology upon cognitive processes and student learning.

Sustained attention is directed focus on a stimulus that is maintained throughout the duration of a cognitive task. According to Tucha, Tucha, Walitza, Sontag, Laffkauter, Linder and Lange (2009), there are 3 stages of sustained attention. Stage 1 consists of attention

attraction to a stimuli (e.g., finding an app of interest on one's mobile device); stage 2 is holding one's attention to the stimuli (e.g., clicking into the app, reading the reviews, then watching it download); and finally stage 3, where an individual releases their sustained attention to the stimuli so he/she may move on to another task of interest (e.g., closing the app).

Shifting attention/task switching is the ability to think in a flexible manner, to alter a problem solving strategy in midst of a task, and to alternate one's attention from one task to another in an efficient manner (Gioia & Isquith, 2004). Also known as set-shifting, this EF skill allows for quick and proficient adaptations to new stimuli. An example of shifting attention is when a child seamlessly alternates between responding to a message on Twitter, then navigating through their Netflix account, and then checking a text message on their phone.

Attentional control is a capacity-based EF skill where an individual selects what they want to pay attention to and ignore what they don't want to attend to. Also known as executive attention, it is frequently referred to as concentration. Attentional control is thought to be related to working memory. Attention control can be imagined when a child is scrolling through their playlist of over 800 songs and electively stops once they get to their song of choice.

Divided attention/multi-tasking is defined as the "attempt" to perform two or more tasks simultaneously. A common theory of divided attention by Kahneman (1973) postulates that there exists a pool of attentional resources that one can divide among multiple tasks. An example of multi-tasking is when a digital native is playing a game, singing to music and texting a friend simultaneously.

These attention-based executive function skills are of considerable interest to researchers and advocates in education as exposure to digital media and heightened hours in screen time may

be shifting patterns of EF-based cognitive processes. In fact, Subramanyan and Greenfield (2008) define digital media as a "psychological tool and a symbol system" that enacts cognitive processes. Essentially, digital media has its own set of characteristics that reflect a symbol system the user must decode, thereby activating a host of cognitive processes, including EF skills of attention.

Screen Time and Attention

Internet headlines, talk shows and radio announcements can over-dramatize the impact of digital media upon cognition with tag lines such as "Empower Your Brain!" or "Concerns for Brain Dsyfunction" and "Causes Seizures!" In spite of these strategically planned headlines, research in the area of digital media and the activation of cognitive processes is still in the preliminary stage and complicated with a vast assortment of "complexities and limitations" that lead to criticisms and scrutiny (Bavelier, Green, Han, Renshaw, Merzenich & Gentile, 2011).

The complexities and limitations of the existing research as described by Bavelier et al. (2011) can be found in a review of the current literature on the impact of media based technology upon attention. Regardless of the mixed results and contradictory findings in this domain, social change and human development theory supports the notion that alterations in EF skills would emerge based on the changing sociodemographic, cultural and learning environments due to massive technology exposure that has permeated our lives.

Video games and attention. Some studies posit that video game playing and television viewing are contributors to childhood attention problems (Swing, Gentile, Anderson & Walsh, 2010; Kenealy, 2002) while others found that the use of media technology did not predict attention problems and in fact improved selective attention and task switching efficiency

(Ferguson, 2011; Green & Bevelier, 2003; Andrews & Murphy, 2006; Hubert-Wallander, Green, Sugarman & Bavelier, 2011) which may support student learning.

Action video game (AVG) research has demonstrated a particularly strong impact upon attention given the strenuous demands on executive functioning. According to Greenfield (2009), divided attention requires the AVG player to track multiple events in various layers of the video game environment which is enhanced in the rich AVG system. Researchers Anderson and Bavelier (2011) contend gamers must develop cognitive strategies to manage the AVG environment, which leads to enhancement in vision, attention and speed of processing. According to Hubert-Wallander et al. (2011), these improvements suggest that "changes in the mechanisms that control attention allocation and its efficiency" exist. Supporting this notion is research conducted by Bavelier, Achtman, Mani and Föcker (2012). Attentional networks in the frontal-parietal area of the PFC are minimally activated in AVG gamers compared to non-gamers who have an increase in activation in this network area. This suggests physiological changes in attentional resources of AVG players who may allocate cognitive resources with more efficiency (Bavelier et. al., 2012). Based on these results, it is likely that children and youth who are AVG players will be much more efficient at learning new academic skills based on their ability to effectively allocate cognitive resources of attention.

Computers and attention. Access to vast amounts of information on the Internet has revolutionized the way digital natives (and digital immigrants) utilize home computers and laptops. Although there is widespread agreement on the benefits of computer usage, concerns and controversies surrounding the volume of use is highly debated. Research has found that constant and unwarranted information (e.g. pop ups) on screen during exploratory searches yields distractors and impacts search-task performance (Kim & Lee, 2011). Conflicting research

by Helder-Babcok (2009) asserts the antithesis: he found no distraction effects during search task performance regardless of type of task or task accuracy. Based on these initial findings, it is possible that digital native students with substantial Internet search experience could have improved abilities to overcome distractors in the classroom and perform school-based tasks with more ease given their exposure to the on-line computer world.

Television viewing and attention. Americans have been fascinated by television since reports of the first televised transmission occurred in 1926 by the young inventor John Logie Baird. Soon after, televisions slowly crept into the homes of Americans throughout the 1930's. Not surprisingly, one of the first studies on television viewing and attention was conducted in 1936 by F. R. Elliott titled *Memory for visual, auditory and visual-auditory material* at Columbia University. Results showed that when participants received auditory stimuli, they were much more adept at attending to information and had higher memory scores compared to stimuli presented visually. This result is not surprising given the auditory exposure to radio systems prior to the invention of the television and supports the Theory of Social Change and Human Development that drives this paper.

Although some research studies support the use of television viewing as a learning tool for comprehension and language development (Lorch & Castle, 1997), most of the research on television viewing has historically provided a negative view of sustained attention to television. Correlations between television exposure and attention-deficit/hyperactivity disorder have been found (Miller, Marks, Miller, Berwid, Kera, Santra & Halperin, 2007) and many researchers warn of the increase in long-term attention problems that could last throughout adolescence and into emerging adulthood due to extensive television viewing (Swing, Gentile, Anderson, & Walsh, 2010; Landhuis, Poulton, Welch, & Hancox, 2007).

Studies conducted on infants, toddlers and preschooler relate a similar picture. Five-year-old children with sustained attention to televisions in their bedrooms appear to have more behavioral problems and social deficits compared to their peers (Mistry, Minkovitz, Strobino & Borzekowski, 2007). Infants and toddlers attention to toys based on length of look time was significantly reduced when a television was on. Researchers suggest this result reflects that television in the presence of an infant is a distractor and moves their attention away from relevant environmental stimuli (Setliff & Courage, 2011).

Regardless of the outcomes of television viewing postulated by research, humans thrive on arousal experiences to the sensory systems as autonomically measured by the electroencephalogram (EEG). Greater cortical activity is present with image-motion stimuli when compared to auditory and non-motion stimuli (Simons, Detenber, Cuthbert, Schwartz & Reiss, 2003). Thus, digital natives will likely continue to be absorbed by their television viewing on various sensory arousal media platforms – computers, phones and tablets.

Cell phones and attention. The research on cell phones and attention has garnered a significant amount of concern due to the high-risk users face when multi-tasking. Considered a "mobile generation," digital natives reportedly check their cell phones or engage in use every 4-6 minutes (Media Literacy Clearinghouse, 2013). An inordinate amount of digital natives' waking lives is spent engaged on their mobile device and research has shown the effects of frequent use upon divided attention.

Studies have demonstrated that cell phone usage distracts visual attention functions during sight-based tasks (e.g. driving, walking across streets) and can impair academic performance by 30% when access to a cell phone is present (Golden, Golden & Schneider, 2003; Froese, Carpenter, Inman, Schooley, Barnes, Brecht, & Chacon, 2012). Other studies have

further substantiated the outcomes of cell phone use and divided attention. Results of a study conducted by Ferlazzo, Fagioli, Di Nocera & Sdoia (2008) suggest that when cell phones are used in conjunction with other tasks, brain coding stimuli into "multiple representations" takes a toll on attention processes and subjects were slow to respond to visual stimuli, particularly when tasks are conducted within an individual's personal space.

In contrast, some studies have shown the benefits of mobile devices such as cell phones in the classroom. Students with behavioral disorders are using hand-held mobile devices to "self-monitor" their attention to academic tasks with much more success than teacher support and interventions (Gulchak, 2008). The use of student text messaging as a learning strategy in ESL classrooms has proven effective as a language learning resource (Kiernan & Aizawa, 2004) and cell phones in college lectures being used as an Audience Response System show an increase in student engagement and participation rates (Tremblay, 2010).

Nature and Cognition

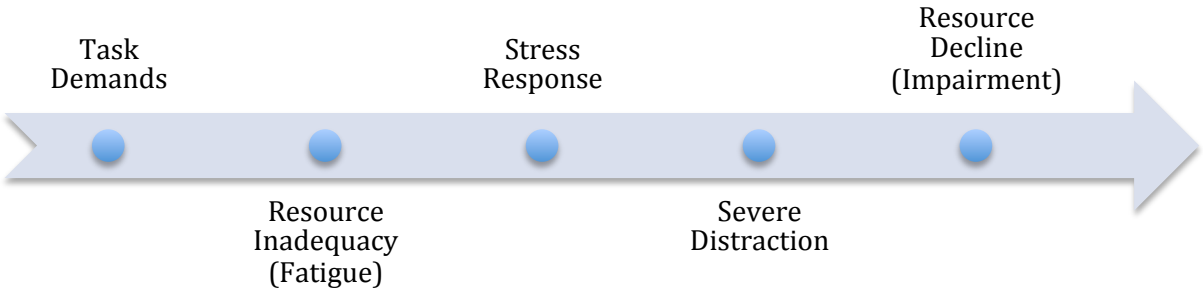
In contrast to the potentially positive effects of technology exposure in terms of EF skills (and particularly selective attention) for the current generation of children and youth, other research has tested the potential benefits of natural environments for attentional and related cognitive skills. In a detailed review of the literature in "Humans and Nature: How Knowing and Experiencing Nature Affect Well-Being," researchers Russel, Guerry, Balvanera, Gould, Basurto, Chan, Klain, Levine and Tam (2013) write that "information, understanding, learning, and acquired capability" are inherent to the human experience due to the ecological systems we are bound by. Based on a review of the literature, some researchers have posited that exposure to the Earth's natural environment enhances cognitive abilities (Kaplan, 1995, Berman, Jonidas, Kaplan, 2008; Felston, 2009). This perspective is not necessarily at odds with a model in which

high exposure to technology enhances EF skills. Rather, it is a complementary theoretical model focusing on the present context in which EF skills are engaged. The model suggests that EF skills may be superior when engaged in a natural environment as compared to an urban one, and natural settings have in fact shown a measurable cognitive advantage in several studies (Russel et al., 2013; Gamble, Howard and Howard, 2014).

A secondary theoretical perspective that drives the current study is Attention Restoration Theory developed by Stephen Kaplan (1983, 1995). Kaplan's integrative framework for understanding the restorative benefits of nature upon cognitive fatigue captures the mechanisms by which task demands lead to stress and eventual attention failure.

Premised on work by William James (1892), Kaplan (1983) asserts that directed attention to a task requires voluntary effort that is "susceptible to fatigue" and thus may lead to distraction. Central to task demands is *focus* while attending to "difficult mental activity in the face of potential distraction" (Kaplan, 1995). Thus, directed attention is a necessary condition for successful mental activity while fatigue is a factor that may lead to ineffective mental activity.

Another factor that Kaplan postulates in his model is the role of stress. Based on stress-oriented theories of attention (Hartig & Evans, 1993), Kaplan integrates critical mental components of attention, fatigue and stress into a model as presented below.



Extended mental effort on any given task demand can lead to fatigue that causes a stress

response. Once a stress response is activated, severe distraction follows which leads to resource decline and eventual impairment of performance on the original task.

Based on this integrated model of attention, fatigue and stress, Kaplan explores the extent to which natural environments can restore individuals' attention resources from fatigue and thus improve attention resources for task demands. Attention Restoration Theory (ART) stipulates that natural environments lead to improvements in directed-attention abilities that are otherwise degraded by "attentional fatigue." Researchers assert attentional fatigue is prompted by "continuous task performance" and decreases one's ability to filter out unnecessary information during a task (Faber, Maurits & Lorist, 2012). According to Faber et. al., study participants who experienced mental fatigue could not selectively attend to correct information and thus had low response accuracies during task performance.

Natural settings, according to ART, have restorative features that can ameliorate attentional fatigue because: (1) they create a sense of "being away" from the usual daily routine, (2) entail pleasant sensory experiences that most people experience neutrally or positively, (3) provide a non-threatening form of arousal related to a reaction to novelty, and thus, (4) ultimately, reduce fatigue and increase selective attention, enhancing task performance when needed.

Comparatively, another typical means of restoring attention abilities is sleep (Kaplan, 1995). Thus, accessing a natural environment, as a resource to alleviate attention fatigue, can be a reliable method to improve task demands that require selective attention.

Of note, the notion that attention can be restored through interaction with the natural environment has a foundation in American history (Kaplan, 1995). Touted as the father of American Landscape Architecture and responsible for the development of urban parks (New

York's Central Park) and National Parks (Yosemite), Frederick Law Olmsted (1865) understood the need for urbanites to restore their focus in conjunction with the natural environment. Particularly aware of the need for nature to restore cognitive faculties, Olmstead believed nature "tranquilizes yet enlivens" the mind. As with original work conducted by William James, Kaplan's ART further incorporates approaches and perspectives by Olmsted. As an inspiration to ART (Kaplan & Kaplan, 1982), Olmsted's writings have further prompted scientific research on nature as a restorative environment for directed attention fatigue.

Several studies based upon ART provide a sample of the types of environments that may lead to improvement of attention abilities (Bernam, Jonides, Kaplan, 2008) and several researchers have tested this theory with promising results (Russel et al., 2013; Gamble, Howard & Howard, 2014; Berman et al., 2008; Felsten, 2009).

According to the Unites States Census Bureau (2011), 81% of Americans live in urban environments and are exposed to multiple sources of sensory stimuli. Sensory elements, such as crowding, noise, pollutants and mass media, can cause overstimulation of the senses and impact how we cognitively synthesize this information. This overload can result in several symptoms such as irritability, restlessness, fatigue and distractibility (Lipowski, 1985). Thus, the benefits of natural environments upon attention appear to be supported in research outlined above. In fact, research in understanding the human benefits of natural environments as compared to urban hardscapes is demonstrating the restorative effects of nature on attention. This phenomenon appears to be particularly critical to human cognition, given the sensory overload of urban environments. Several studies as reviewed below outline the cognitive benefits of natural environments.

In a study by Felsten (2009), students rated indoor settings with dramatic nature murals

that included water as far more restorative than settings with window views of real but mundane nature within an urban setting where hardscape was present. Further studies conducted by Berman et al. (2008) compared the restorative effects of nature by asking young adult subjects to either view pictures of nature or an urban hardscape. Researchers found that merely viewing nature pictures can improve directed attention abilities. In more recent study by Gamble et al. (2014), researchers found that viewing pictures had a restorative effect upon executive attention in an older adult population as measured by the Attention Network Test.

A final study assessing ART as a framework conducted by Berman (2008) postulates that natural environments are filled with novel and intriguing stimuli that "modestly" access human attentional resources and thus allow directed attention abilities to replenish after exposure to nature. These researchers compared young adults who walked in nature versus those who walked in an urban environment. Results showed that walking in nature had a significant impact on improved directed attention abilities thus supporting the model of the beneficial effects of nature upon attention (Berman et al., 2008). These studies collectively demonstrate that even quick exposures to nature can at least temporarily boost executive and directed attention.

Although these studies support the positive influence of nature upon attentional resources and restoration, the research in this domain in sparse within the adult population (Russel et al., 2008) and virtually non-existent with a population of children. The primary study that prompted this line of research that included a child population was conducted by Uhls, Michikyan, Garcia, Morris, Small, Zgourou and Greenfield (2014). Researchers sought to understand the impact of nature and urban environments upon children's social development by evaluating the influence of the frequency of screen use upon children's detection of non-verbal emotion cues. Student's abilities to detect these cues were evaluated in an outdoor education camp setting without access

to multi-media screen usage (experimental group) and an urban school setting with access to multi-media screen usage (control group). Results of this study found that after five days in an outdoor education camp setting without screens, children had better abilities to detect non-verbal communication compared to their matched counterparts on-screen and in an urban school environment with access to multi-media sources. Although authors surmise these changes were likely due to the intense social interaction experienced by children in an outdoor education setting, the current study will further consider the impact of the natural environment upon cognitive restoration.

The body of research testing ART has demonstrated the cognitive benefits of learning in natural settings. It appears natural settings have a replenishing effect on cognition and may be complementary to the long-term effect of technology exposure of digital natives.

Giftedness

Gifted children, by definition, are relatively quick learners. Characteristics of gifted children include abilities to understand new ideas and concepts as well as being quick in seeing relationships between objects and ideas (Rogers, 1986; Smutney, 2011; McCollister & Saylor, 2010). It is well documented that gifted children have strong verbal and spatial abilities, and are stimulated by novel situations as evidenced by intelligence quotient (IQ) scores, exceptional ability and uncommon talents (Davidson & Sternerg, 1984; Pfeiffer & Yermish, 2014; Sweetland, Reina & Tatti, 2006). Furthermore, gifted children have a far different trajectory of learning potential and have strong leadership skills when compared to their non-gifted counterparts (Calero, Belen & Roble, 2011; Sternberg, 2011).

Much of the discussion on gifted children focuses on classroom environments. Research evaluating instructional delivery, teacher professional development, school-based curriculum

enhancements and identification procedures for gifted children tend to dominate the literature (Assouline, Colangelo, Heo & Dockery, 2013; Peterson, 2013; Coleman, 2014; Rowe, Dandridge, Pawlush, Thompson & Ferrier, 2014). However, not documented in the literature on gifted students is how a natural versus an urban setting can impact gifted children's executive function skills. It is presumed that giftedness may allow children to take particular advantage of novel learning environments that integrate critical thinking approaches, as when urban school children are educated in natural settings (e.g., school-based camps). Thus, this study further aims to explore whether natural education settings may particularly benefit the cognitive performance of gifted children. The enhanced setting such as nature-based education may benefit gifted children based on their optimal learning needs (McCollister & Saylor, 2010) . In fact, giftedness may be a key moderator of the effect of setting on EF skills and is a research question explored in the present study.

Research Questions and Hypotheses

The literature on technology exposure is quite dichotomous and paints both an optimistic and pessimistic picture of digital native learning based on alterations of EF skills of attention. In fact, research over the past two decades supports both learning impairments as well as learning strengths of digital natives in relation to attention. Due to the conflicting results of several studies relating to digital media screen time and attention, the present study hopes to elucidate the impact of digital media upon attention in pre-adolescent children.

Following up on the results of the study conducted by Uhls, et. al (2014), this study was also designed to consider the effects of setting (natural vs. urban) upon a task performance in the EF domain of attention rather than a social-cognitive domain. The following research questions were developed:

1. Do pre-adolescent digital natives with greater frequency use of multi-media sources, particularly computer usage and video game playing, exhibit superior visual selective attention in comparison with pre-adolescent digital natives with a lesser frequency use of multi-media sources?
2. Does a natural (vs. urban) test setting enhance the visual selective attention of pre-adolescent digital natives?
3. Do gifted children benefit more from an nature-based education setting than non-gifted children?

The following corresponding hypotheses were developed in light of previous research and theory:

Hypothesis #1: ***Pre-adolescent digital natives with greater frequency use of multi-media sources, particularly computer usage and video game playing, will exhibit superior visual selective attention in comparison with pre-adolescent digital natives with a lesser frequency use of multi-media sources.***

Hypothesis #2: A natural test setting will enhance the visual selective attention of preadolescent digital natives.

Hypothesis #3: ***A difference in attention will occur between gifted preadolescent children compared to non-gifted children when working in a naturalistic outdoor setting.***

Preliminary Study

Method

The primary cognitive assessment to test attention in this study was the Test of Everyday Attention for Children (TEA-Ch). The TEA-Ch was originally designed for individual

administration by test developers. In the present study, researchers adapted the TEA-Ch for group administration due to time and location constraints. In order to test the efficacy of the altered administrative procedures of the TEA-Ch, this preliminary study was designed to evaluate the relationship between individual and group administration of the TEA-Ch.

Research Design

The research design employed is a repeated measures correlational method. This method is the systematic investigation of relationships among two or more variables without determining cause and effect. This preliminary study sought to identify the correlation between individual and group administration of the TEA-Ch to validate its use in the main study as a group administered test.

Participants

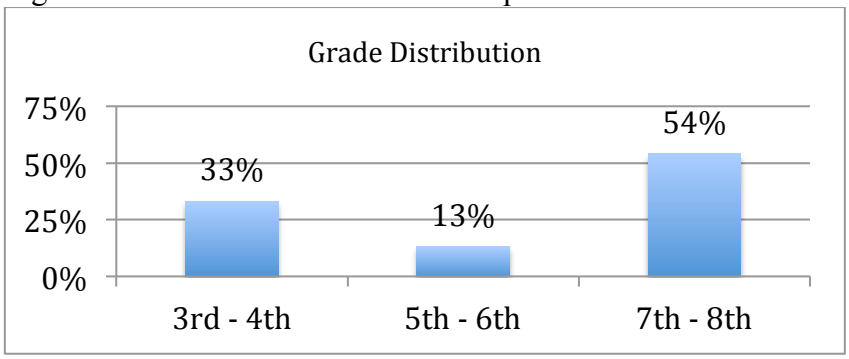
A total of 24 youth participated in the preliminary study after being recruited from a local soccer program through announcements to coaches and parents. Of the participants, 66% were females and the average age was 11.2 years. All participants were enrolled in third through eighth grades at the time of administration of the TEA-Ch.

Table 1.
Demographic Composition of Preliminary Study Participants

Ethnicity	**N**	**%**
Latino	20	84%
Caucasian	2	8%
Asian	2	8%
Gender	**N**	**%**
Male	8	34%
Female	16	66%

Children attended various schools throughout the community and included public, private and parochial learning institutions. A grade distribution is presented below.

Figure 1. Grade Distribution of Participants



Procedures

Participant recruitment. A total of 27 youth were recruited from a local soccer program for individual and group administration of the TEA-Ch. Researchers held team meetings with parents, coaches and players to introduce the research study. Children whose parents completed the study consent forms were scheduled for administration of the TEA-Ch. Due to absenteeism from soccer program on scheduled assessment dates, twenty-four youth of the twenty-seven actually completed the TEA-Ch assessments in both conditions.

Measure. The Test of Everyday Attention for Children (TEA-Ch) is a sensitive, efficient and economical assessment to identify attention skills in children and youth aged 6-16 years of age. Developers have designed the TEA-Ch as an assessment tool for educators, researchers and clinical psychologists interested in evaluating attention characteristics and possible dysfunction. Standardized and normed for children aged six through sixteen years, the TEA-Ch consists of nine subtests evaluating various sub-types of attention. All sub-tests are timed and children's task performances are based on accuracy of responses. Three sub-tests Score!, Score DT and Code Transmission are tests of sustained attention. Sky Search and Map Mission are sub-tests that evaluate selective and focused attention while Creature Counting and Opposite Worlds assess attentional control (e.g. concentration) and task switching. Sky Search DT evaluates

sustained-divided attention and Walk, Don't Walk measures sustained attention as well as response inhibition. Developers modified sub-tests of the Test of Everyday Attention (TEA) for adults to create the TEA-Ch.

Selection of TEA-Ch sub-tests was determined after comprehensive pilot administration of all sub-tests over a four-month period prior to the onset of the current study. TEA-Ch sub-tests selected as a dependent variable of this study met three criteria:

1. Sub-test had a "game-like" quality which engaged pilot study participants
2. Sub-test was adaptable to group administration procedures
3. Pilot scores of Sub-test had variability between participants

Three sub-tests, Score!, Score DT and Opposite Worlds, were not suitable for group administration procedures. Adaptability of these sub-tests to group administration appeared to significantly alter the sub-test and thus, dependent variable score results may be compromised. The sub-test Walk, Don't Walk had very little score variability amongst the pilot participants. Nearly all of the youth who took this sub-test achieved the maximum correct possible with similar timing scores. Since these sub-tests did not meet the criteria above, they were eliminated from the current study.

Repeated TEA-Ch administration. The four sub-tests administered to evaluate individual versus group administration of the TEA-Ch were Sky Search, Sky Search DT-Motor Control, Map Mission and Creature Counting. All participants received individual administration of the TEA-Ch by trained research assistants over a three-month period as recruitment was ongoing. After a four-week wait time, participants received group administration of the TEA-Ch. All TEA-Ch assessments were administered during after-school hours at a high-school athletics department "club house" where participants train and practice.

Results

A paired samples t-test was first conducted to compare the difference between Time 1 individual TEA-Ch scores (T1i) and Time 2 group (T2g) TEA-Ch scores. The TEA-Ch sub-test scores evaluated were Sky Search – C (sustained attention), Sky Search MC – F (motor control and sustained attention), Sky Search – G (Sustained and Selective Attention), Map Mission (selective attention) and Creature Counting – L (attentional control and task switching).

Results indicate that there was not a significant difference in the scores of Sky Search-C, Sky Search-G, Map Mission and Creature Counting-L between Time 1 (individual administration) and Time 2 (group administration). No significant difference in the scores for Sky Search-C individual (M=4.18, SD=1.33) and Sky Search-C Group (M=4.04, SD=1.55) conditions, $t(19)=.447$, $p = .660$, were found. Similarly, there was not a significant difference in the scores for Sky Search-G individual (M=3.4, SD=1.26) and Sky Search-G group (M=3.4, SD=1.47) conditions; $t(19)= -.019$, $p = .985$. In reference to Map Mission, no significant difference in the scores for Map Mission individual (M=48.6, SD=10.5) and Map Mission group (M=51.5, SD=9.7) conditions, $t(19)= -1.2$, $p = .246$, were found. Finally, there was not a significant difference in the scores for Creature Counting-L individual (M=3.40, SD=1.34) and Creature Counting-L group (M=3.28, SD=.732) conditions; $t(14)=.464$, $p =.649$.

However in the Sky Search Motor Control task, a significant difference in the scores for Sky Search-F individual (M=.784, SD=.204) and Sky Search-F group (M=.644, SD=.161) conditions, $t(19)= 3.04$, $p =.007$, was found. This result may reflect a timing difference between the two group conditions. Most participants increased their speed of this task, regardless of age, when in the group condition. From observations during test administration, participants appeared to have a more competitive spirit while sitting with a group of peers. In addition, Sky

Search MC requires less cognitive energy. These two characteristics, ease of task and competition, appear to play a role in the difference between the individual and group administration conditions for this sub-test.

Intra-class correlations were also conducted to provide a measure of the association between individual and group administration sub-test scores of the TEA-Ch. Results indicate sub-test scores between Time 1 Individual (T1i) and Time 2 Group (T2g) were significantly correlated for all composite scores and are reported below.

Table 2.
TEA-Ch Sub-Test Intra-Class Correlations

TEA-Ch Sub-Test	**Intra-class Correlation**	**Sig.**
Sky Search - C	0.701	0.006
Sky Search - F	0.542	0.048
Sky Search - G	0.651	0.013
Map Mission	0.580	0.033
Creature Counting L	0.675	0.022

Due to the strong correlations and significance levels of each of the TEA-Ch sub-test composite scores, it was determined the modified group administration procedures were a viable methodological approach for the main study of the current research project.

Main Study

Method

Research Design

The research methodology used to address my research questions and hypotheses is a mixed correlational and quasi-experimental research design using a pre and post-test approach. Instead of random assignment, which was not possible, the groups of participants were matched, as described in the next section.

Participants

Both the experimental and control groups were comprised of fifth-grade students recruited from a large urban school district in southern California. All students (n=94) attended the same elementary school and were enrolled in the fifth-grade. A majority (56%) of the participants were male and 44% were female. The school is located in a predominantly Latino neighborhood and thus, 77% of the students were Latino.

Table 3.
Demographic Composition of Main Study Participants

Ethnicity	**N**	**%**
Caucasian	4	4%
Hispanic	72	77%
Asian	7	7%
Mixed Ethnicity	11	12%
Academic Identification	**N**	**%**
Gifted	40	43%
Non-Gifted	54	57%

A total of 43% of the participants were gifted and classified as such based on intelligence test screenings, state standardized test scores, and teacher recommendations. Teacher recommendations to the gifted magnet program were given to the school Principal and Gifted Coordinator when students were judged as achieving beyond that of their peers in a general education classroom setting. All gifted students in this study were enrolled in the same classroom with gifted peers. Teachers of the gifted classrooms had specialized training on giftedness and gifted education from a research professional from a large local university.

All participants were asked to identify their parent's level of education and occupation. Several of the participants did not know their parent's educational histories and information provided reflects 60% of mothers' education levels and 77% occupational roles. In regards to

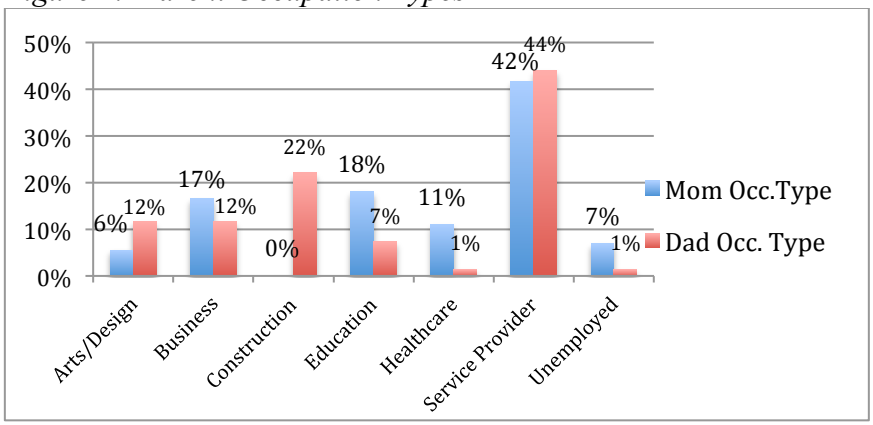
fathers, data reported reflects 44% of their education levels and 72% of their occupation roles. Approximately 30% of the participants have parents who have graduated from high school while 49% of parents have either some college experience or are college graduates.

Table 4.
Parent Education Status

Education Level	**#**	**%**
Some High School	4	4.1%
High School Grad	30	30.9%
Some College	16	16.5%
College Graduate	31	32.0%
Graduate School	16	16.5%

Data for parent occupation types was also synthesized and reported below. The majority of parents were service providers and in fields such as "personal care, food service and maintenance/repair." A total of 8% of parents were unemployed while fathers' next most frequent occupation was "construction trades" and mothers' next most frequent occupations were "education" and "business."

Figure 2. Parent Occupation Types



Procedures

Sampling procedures. The school was selected because it had a pool of fifth-grade classrooms with variation in their student population. Some of the classrooms held gifted

students while the other classrooms provided general education to non-gifted students. The school's specialized gifted magnet program utilized stringent criteria for identification of giftedness. As giftedness is a factor in this study, accurate identification was necessary as access to school records with detail of IQ scores was not available. Additionally, this urban school was selected because it had an annual outdoor education opportunity for all fifth-grade students to attend.

Parent recruitment. Researchers coordinated with school administration to participate in general school parent meetings. To accommodate schedules of all parents, school officials held parent meetings both in the morning and evening. Researchers were invited to attend three parent meetings to introduce the study and to garner participant interest. Parent consent forms were given to all in attendance at meetings. Some parents opted to sign and submit consent forms directly to the lead researcher at the end of meetings while others sent consent forms with their children to return to the classroom teacher at a later date.

Student recruitment. Researchers visited each of the participating fifth grade classrooms and presented the research to the students in order to gain interest and participation. During the classroom visits, background information was given about the study, the university and participation tasks. Each student received a parent consent form to be signed and returned, confirming participation. During classroom visits, a raffle was announced to students. All those who participated had their name entered into a raffle and three students won movie theatre gift cards. In addition, all fifth-grade classrooms had an ice-cream party at the end of the research sessions.

Attrition. Attrition during the study was due to uncontrollable factors. Some participants who were cleared for involvement, via the parent consent form, ultimately did not participate due

to absenteeism, left school early prior to assessment, or were participating in an out-of-class activity. Out of the 62 participants that were confirmed with consent forms, 52 participated in the study.

Nature education (camp) setting procedures. During the Spring of 2013, four fifth-grade classrooms embarked on a five-day field trip to a camp located in a National Park in California. Fifth-grade classrooms rotated to camp over a two-week period as the outdoor education school could not accommodate all classrooms during the same week. Researchers traveled to this site each week to assess student attention skills on Monday upon their arrival to camp (pre-test) and again on Friday to assess students after their outdoor education experience and just prior to their camp departure (post-test).

Upon arrival to the camp and after a seven-hour bus ride, students were given their cabin assignments, bunk-mates and outdoor-education teacher group. After students unloaded and unpacked their gear to their assigned rooms, student groups of 10-12 were administered the TEA-Ch in the camp "Sun room." Pre-test assessments were administered over a 2-hour period on Monday afternoon. Modified instructions of the TEA-Ch were delivered to each group. Instructions were redesigned by researchers to accommodate group administration and were standardized across all groups. Three researchers monitored and administered the TEA-Ch to each group in the outdoor education setting.

Post-test assessments of the TEA-Ch were conducted on the fifth day of camp attendance and just prior to departure from Yosemite National Park. Again, groups of approximately 10 students were assessed by researchers' modified, yet standardized, instructions of the TEA-Ch.

Urban setting procedures. During the Spring of 2014, researchers returned to the same school and again conducted parent and student recruitment procedures in fifth-grade classrooms

as previously outlined. The wait-time of one-year between Nature Education Setting and Urban Setting group assessments was considered to be an important methodological decision for two reasons. 1) Researchers desired to have a matched comparison group. 2) Researchers desired the comparison group to be at the same stage of cognitive development (second semester of fifth-grade) as the Nature Education Setting group.

Once confirmed for participation, Urban Setting group participants were divided into groups of 10-12 for group administration. Pre-test assessments were conducted on Monday afternoon in an unused school classroom typically used for teacher meetings and professional development. Post-test assessments were conducted five days later on Friday in the same classroom setting as pre-test administration. As with the Nature Education Setting group, modified yet standardized instructions of the TEA-Ch were given for each sub-test. Three-four researchers monitored and administered the TEA-Ch to each group. The five-day time gap in-between the pre- and post-tests were implemented to evaluate any level of change in scores between the two tests as well as to be consistent with the experimental procedures. Upon completion of sub-test administration, the researchers gathered all of the information recorded from the activities and repeated this process with the next group of participants.

Measures

TEA-Ch. With multiple sub-tests to evaluate attention skills, the TEA-Ch has been found to be both time and cost effective (Carper, 2003). The TEA-Ch has the ability to quickly evaluate student Executive Function skills in multiple domains of attention, thereby making it an attractive measure for researchers.

The four sub-tests selected for the main study were Sky Search, Sky Search DT, Map Mission and Creature Counting. Sky Search and Map Mission are sub-tests that evaluate

selective and focused attention while Creature Counting assesses attentional control (i.e.. concentration) and task switching. Sky Search DT evaluates sustained and divided attention. The time taken to administer each sub-test ranged from one minute to approximately ten minutes. The length of time to administer the four sub-tests of the TEA-Ch to participant groups was approximately thirty-minutes. This time-frame includes classroom transition, test instructions and actual sub-test tasks.

Media Survey. The survey used to determine frequency of digital media use was a 31-item Media Survey developed by Uhls (2012). This survey was used in previous research to assess differences in social skills between children in an urban setting versus children in a nature education setting (Uhls, Michikyan, Garcia, Morris, Small, Zgourou, & Greenfield, 2014). The Media Survey asks questions relating to types of digital media access, frequency of use and typical behaviors during use. The four primary digital media sources include cell phone, computers, video games and television. Question examples include "Do you our your family have a computer in the home?" "How many texts did you send yesterday?" and "How many windows do you typically have open on your computer screen?" All media survey responses for each media source domain used in the study analyses are on a 6-point likert scale. As the media survey questions refer to daily media use frequency, responses range from "never" to "more than 4 hours."

The Media Survey also asks questions relating to social skill development and friendship networks (e.g. "I see my friends outside of school."). In addition, basic demographic questions (e.g. ethnicity and number of siblings) as well as parent level of education and occupation are asked on the Media Survey.

Questions from the media survey were culled to generate sets of composite scores within

each primary digital media categories of cell phones, computers, video games and television viewing. Questions were then sub-categorized to reflect digital media use type (eg. social) and frequency of use. The media survey asked only one question regarding television viewing and thus is not presented below in Table 5.

Table 5.
Media Survey Digital Media Use Type

Cell Phone Use	**# Questions**	**Sample Question**
Social	6	"How often do you IM/Chat"
Recreational	7	"How often do you play games?"
Computer Use	**# Questions**	**Sample Question**
Social	4	"How often do you video chat?"
Recreational	4	"How often do you watch a movie?"
Productivity	3	"How often do you create content?"
Video Game Use	**# Questions**	**Sample Question**
Frequency	2	"If you play video games every day, on, on average, how often do you play?"

Inter-correlations were conducted on sets of questions hypothesized to act as a covariate of aim 1 in this study. Results of alpha analyses indicate a robust result for *cell phones – social use* and *cell phones – recreational use*. High alphas were seen for *computer use – social and recreational*. Low alphas were revealed for the items composing *computer use- productivity,* and thus these questions were removed as potential covariates for this study. The two frequency questions culled for the composite variable for *video game use – frequency* had high alphas. All alphas of digital media use categories are presented below.

Table 6
Digital Media Use Alpha Scores

Cell Phone Social	**Inter-item Correlation**
phone_call12	0.797
phone_text12	0.795
phone_email12	0.812

phone_games_friends12	0.766
phone_vidchat12	0.808
phone_instmsg12	0.735
Chronbach's Alpha	**0.816**
Cell Phone Recreational	**Inter-item Correlation**
phone_internet12	0.906
phone_youtube12	0.904
phone_movie12	0.919
phone_games12	0.921
phone_pics12	0.917
phone_videos12	0.916
phone_apps12	0.897
Chronbach's Alpha	**0.923**
Computers Social	**Inter-Item Correlation**
comp_instmsg16	0.669
comp_games_friends16	0.643
comp_vidchat16	0.71
comp_soc_network16	0.674
Chronbach's Alpha	**0.737**
Computers Recreational	**Inter-Item Correlation**
comp_internet16	0.784
comp_youtube16	0.706
comp_movies16	0.809
comp_games16	0.794
Chronbach's Alpha	**0.821**
Video Games Frequency	**Inter-Item Correlation**
vidgames_day_20	-
vidgames_yr_21	-
Chronbach's Alpha	**0.784**

A final analysis of the composite variables was then conducted to assure strength of the alpha scores. Inter-item correlations for composite variables reveal strong alpha scores for computer, cell phone and overall composite variables to be used as covariates. Alpha scores of the combined digital media composite variables used in this study as a covariate are presented below. Alpha scores reflect the strength of the combined composites used as a "combined

composite" variable. Inter-item composite variable scores for video games was previously reported in Table 6.

Table 7.
Digital Media Use Composite Alpha Scores

Overall Composite Variables	**Inter-item Correlation**
Composite Cell-Social	0.461
Composite Cell-Recreational	0.525
Composite Computer-Social	0.587
Composite Computer-Recreational	0.759
Chronbach's Alpha	**0.667**

Cell Phone Composite	**Inter-item Correlation**
Composite Cell-Social	-
Composite Cell-Recreational	-
Chronbach's Alpha	**0.881**
Computer Composite	**Inter-item Correlation**
Composite Computer-Social	-
Composite Computer-Recreational	-
Chronbach's Alpha	**0.594**

Analysis Plan

Repeated-measures analysis of covariance (ANCOVA) will be used to test the three hypotheses in this study. In this model, TEA-Ch scores at the beginning and end of the school week are the repeated measures DV. There are two IVs: setting (nature/camp setting vs. urban environment) and giftedness (gifted vs. non-gifted children) for aims 2 and 3 respectively. Frequency of digital media use based on the media survey (Uhls, 2012) composite variables will be used as a covariate to assess impact of screen-time upon attention (Aim 1). Aim 2 will be tested by examining the main effect of setting on TEA-Ch scores. Aim 3 will be tested by

examining the interaction of setting, giftedness, and time, with expectation of a difference between gifted and non-gifted children over the course of the week in a natural setting.

Results

As part of the standardized scoring procedures of the TEA-Ch, subtest composite scores are calculated and used in the analysis of all aims of this study. Detail of composite scores for all pre and post-tests of the TEA-Ch used in this analysis are as follows:

1. Sky Search Pre and Post G (SS Pre G; SS Post G): This composite score reflects a combination of the accuracy and timing scores of Sky Search and Motor Control sub-tests. This score reflects an overall attention score and includes and evaluation of sustained attention, selective attention, speed of processing and motor control.
2. Creature Counting Pre and Post L (CC Pre L; CC Post L): This composite score reflects attentional control for task switching and divided attention. This sub-test score is based on accuracy and timing of the number of switches required in the task.

Although the Map Mission sub-test met the criterion for inclusion of this study during pilot assessments, this sub-test did not meet criteria #3 – variability in scores between participants - in relation to main study fifth-grade participants. Thus, the Map Mission sub-test was not used in this study.

A review of the media survey descriptive statistics revealed that although 89% of participants report having daily access to cell phones, computers, video games and televisions, the frequency of daily use, as measured on the 6-point scale of "never" to "more than 4 hours" (0= never; 1= less than 1 hour; 2= 1-2 hours; 3= 2-3 hours; 4= 3-4 hours; 5= more than 4 hours), revealed a surprisingly low overall mean of total daily digital media frequency use per device. In relation to computer usage (Median=.75, M=.92, SD=.84), the frequency of computer use was

less than 1 hour per day. The range for time spent engaged in computers was reported as 0 ("never") to 3.6 (2-3 hours per day) and majority of respondents reported "never" using computer for social or recreational purposes. Student participants reported that cell phone use (Median=.00, M=.70, SD=1.09) on a daily basis was also "less than 1 hour per day" with the majority reported "never" using a cell phone for other than emergency purposes. The range for cell phone activity was 0 ("never") to 4.3 (3-4 hours per day). In relation to video game activities (Median=1.4, M=1.5, SD=1.4), the average frequency of use was approximately one-hour per day. The range for time spent engaged in gaming was from "never" to "3-4 hours per day." Although participants engaged in television viewing more so than any other digital media source, participants disclosed they watched television just under 2 hours per day (Median=2.0, M=2.4, SD=1.2).

Based on an evaluation of median scores, the majority of study participants disclosed they spent approximately 3.5 hours per day engaged in digital media. These findings reflect a low daily use of digital media compared to national statistics. Research conducted by the American Academy of Pediatrics (2015) report that children spend an average of seven-hours a day using various electronic devices including televisions, computers and cell phones. Although study participants had adequate access to digital media resources at home, most engaged with these tools about half the amount of time compared to their national counter-parts.

Upon further examination of digital media access of the study sample, many students reported they shared a cell phone with a family member and almost all shared a family computer. Very few students in the study population had a television or computer/laptop in their own bedroom, which may have reduced their frequency of overall digital media use. Although students reported having access to digital media items daily, very few had their own personal

devises to access as desired. Rather, these students shared digital media systems with family members (87% reported having at least one sibling at home). This dynamic may be indicative of cultural values and/or socioeconomic status. Limited technology use of this sample appears to be critical to results of this study and has implications for Aim #1 study outcomes.

Aim #1 Results

Hypothesis #1 of the current study is: ***Pre-adolescent digital natives with greater frequency use of multi-media sources, particularly computer usage and video game playing, will exhibit superior visual selective attention in comparison with pre-adolescent digital natives with a lesser frequency use of multi-media sources.*** This was tested by evaluating the digital media composite scores as the covariate in the analysis of covariance model. Evaluating this covariate in the ANCOVA model assesses the impact of long-term screen-time exposure upon attention (Aim 1) and reflects a quantification of "frequency use of multi-media sources" per the hypothesis.

The composite variables of the media survey questions that assess frequency use of multi-media sources (see Table 6) were not significant covariates in the ANCOVA predicting TEA-Ch scores. Further permutations of the media survey variables (composite mean score of all composites; composite mean scores of 24-items identified with combined high alpha scores) were also computed to test the covariate in this model. Alterations of the media-use composite covariate further indicated non-significant results of this covariate. Hypothesis #1 of this study was not supported.

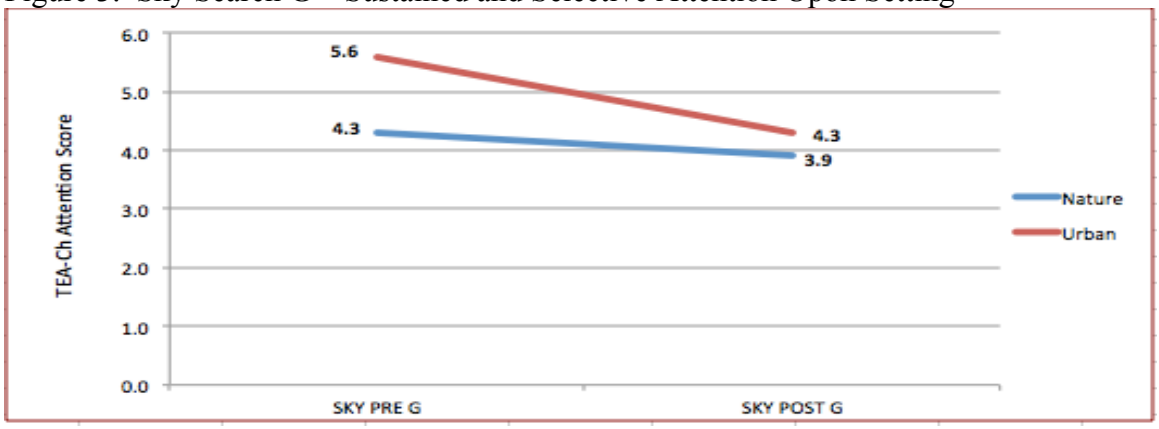
Aim #2 Results

Hypothesis #2 is: ***A natural test setting will enhance the visual selective attention of preadolescent digital natives.*** To evaluate this hypothesis, composite sub-test scores of both the

pre and post assessments of the TEA-Ch were used as the dependent variable in the repeated-measures analysis of covariance model. The independent variable was setting type – urban (school) or nature (outdoor education). To further substantiate hypothesis testing, an evaluation of confidence intervals was conducted on all models to assess the variability of the observed statistics and the probable relationship these variables have upon the larger "population from which the sample is drawn" (Simon & Reid, 1999). This level of precision and accuracy allows for evaluation of the "magnitude and probability" of the main effect. Due to the nature of the scoring procedures of the TEA-Ch sub-tests, lower scores presented in the results reflect superior performance on tasks.

The repeated-measures ANCOVA model revealed that the administration setting produced a significant difference in selective and sustained attention as measured by Sky Search G, $F(1,87) = 5.350$, $p < .05$. As noted in Aim 1 results, above, the covariate Global Media Use was not significant $F(1, 87) = .350$, $p > .05$ in this or any other ANCOVA model. An interaction effect between time and setting was not found to be significant as $p > .05$. This result suggests that a natural environment may enhance visual selective attention of pre-adolescents.

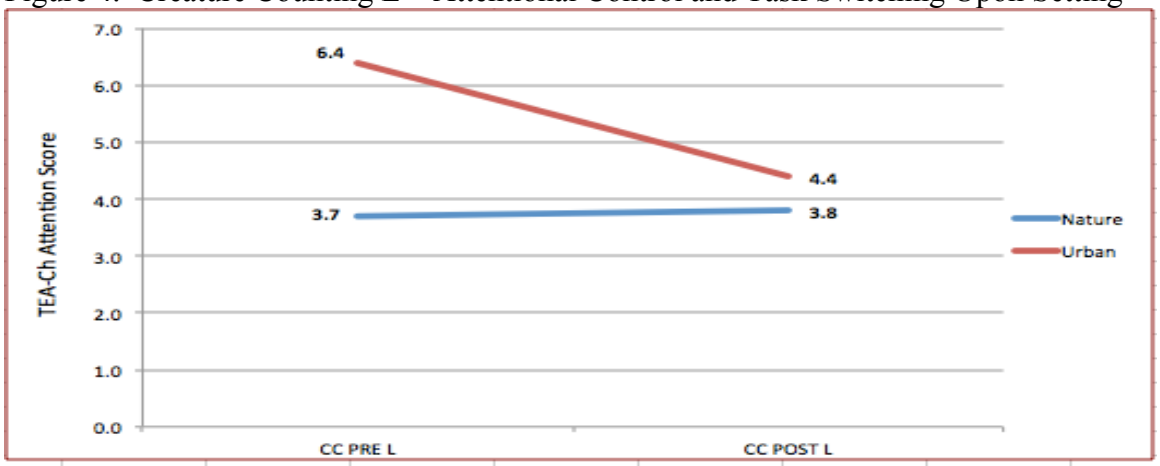
Figure 3. Sky Search G – Sustained and Selective Attention Upon Setting



There was a significant main effect for setting, $F(1, 85) = 13.630$, $p < .01$, upon the dependent variable Creature Counting L, which assesses attentional control and task switching.

Evaluation of the covariate Global Media Use Sum did not reveal significant results $F(1, 89) = .589$, $p > .05$ in this ANCOVA model. An interaction effect between setting and time was not found to be significant as $p > .05$. However, visual inspection suggests that the effect of setting may have been greatest at T1, prior to the repeated administration given to the urban setting group at T2.

Figure 4. Creature Counting L – Attentional Control and Task Switching Upon Setting



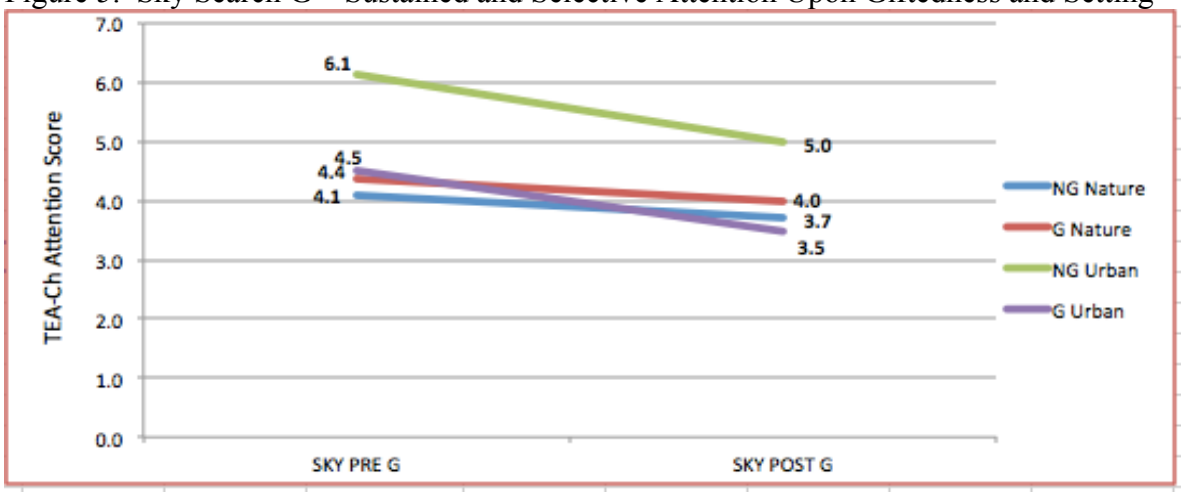
Results of the repeated-measures analysis of covariance support Hypothesis #2. The type of setting appears to have an effect upon the visual selective attention, attentional control and task-switching skills of pre-adolescent digital natives as assessed by the Test of Everyday Attention for Children.

Aim #3 Results

Hypothesis #3 is: ***"A difference in attention will occur between gifted preadolescent children compared to non-gifted children when working in a naturalistic outdoor setting".*** This was also tested with composite sub-test scores of both pre and post assessments of the TEA-Ch. These scores were used as the dependent variable in the repeated-measures ANCOVA model and the independent variables were giftedness as identified by the student's participation in a highly gifted magnet program as well as setting (urban, nature).

Repeated-measures ANCOVA results revealed a significant main effect for giftedness upon the dependent variable Sky Search G, which assesses sustained and selective attention, $F(1, 87) = 4.834$, $p < .05$. A significant interaction was further found between giftedness and setting, $F(1, 87) = 10.695$, $p < .01$.

Figure 5. Sky Search G – Sustained and Selective Attention Upon Giftedness and Setting

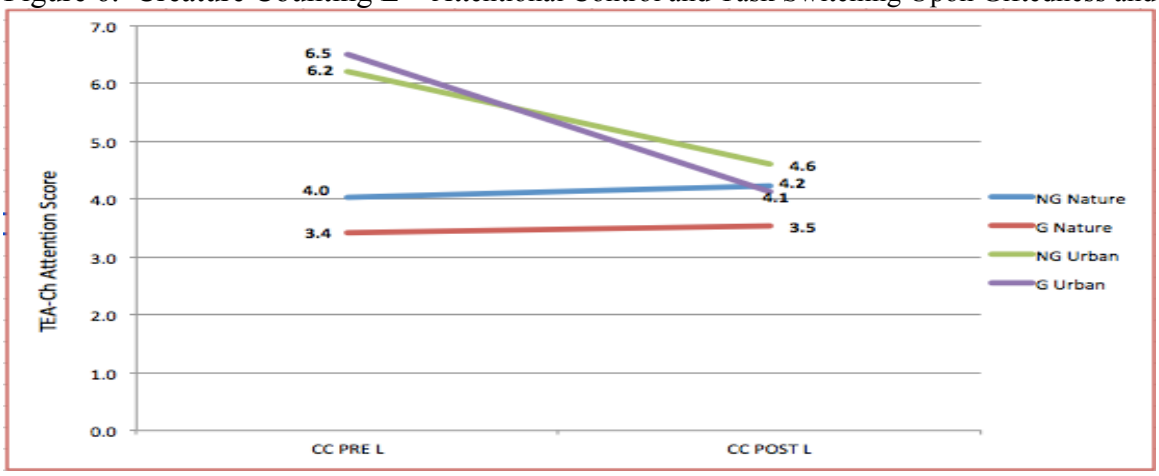


These results indicate that non-gifted students in urban settings (school) perform below gifted students in either setting and below non-gifted students in a natural setting at pre-test administration. It appears as though a natural environment particularly benefits non-gifted students' sustained and selective attention skills.

In relation to attentional control and task switching as measured by Creature Counting L, there was no significant main effect for giftedness, $F(1, 85) = .854$, $p > .05$ nor a significant interaction effect, $F(1, 85) = .436$, $p > .05$. However, upon further evaluation of confidence intervals (CI), data revealed a significant difference at the $p < .05$ for environmental setting at T1 due to non-overlapping CI. In short, both gifted and non-gifted students performed better than their peers when they were tested in a natural setting. Conversely, both gifted and non-gifted students in an urban school environment performed below that of gifted and non-gifted students

in a natural environment. Although there was not a significant main effect between gifted and non-gifted students, it appears as though attention tasks performed in a natural setting benefited both types of students.

Figure 6. Creature Counting L – Attentional Control and Task Switching Upon Giftedness and Setting



Discussion

With the pervasive use of technology in the United States, this study attempted to elucidate the impact of screen time usage upon pre-adolescent children's selective attention in two different settings, and of the impact of those settings, as well as giftedness, on children's selective attention. Aim 1 results failed to support the hypothesis in that there was no relationship between attention skills and digital media use. Results of Aim 2 supported the hypothesis in that setting of test administration produced a significant difference in selective and sustained attention of study participants. Aim 3 had mixed results depending on the TEA-Ch sub-test administered. Gifted students in both urban and natural settings significantly outperformed their peers in an urban education environment on sustained and selective attention sub-tests. However, there was no significant difference between gifted and non-gifted students on the more difficult attention sub-test that measured task-switching. These findings are further expanded and discussed in the context of previous research and theory.

Aim #1 – Frequency of Media Use and Visual Selective Attention

Hypothesis #1 of the current study was not supported. Based on the relevant literature on the impact of screen time upon children and youth, it was hypothesized that children with higher levels of digital media exposure would exhibit superior visual selective attention compared to those with less frequency of digital media use. The results failed to support this hypothesis. Tests of association between the TEA-Ch sub-test scores with the Global Media Use Composite score (24-items) revealed no relationship between these two variables. Although nearly 90% of the participants reported access to various digital media sources in their home, the average daily digital media combined use was 3.5 hours. These usage patterns may reveal some relevant culture-based factors relating to screen-time. Since participants of this study were dominantly Latino, it is possible that cultural expectations relating to family interconnectivity and daily interactions may play a role in the frequency of digital media use.

In spite of the low screen-time usage figures of the participants in the current study, cultural variations of household media use are frequently seen in the literature and seem to present a different picture. Some studies suggest that African-American and Latino children spend more time with screen media than their white peers before the age of 8 years old (Common Sense Media, 2013). Latino youth aged eight through eighteen years typically consume "four and a half more hours of media a day", significantly more than White youth (Center on Media and Human Development, 2011). Much of the difference in screen-use in the literature is seen in rates of bedroom televisions. Sixty-six percent of Latino children report having a bedroom television with many premium cable channels compared to 28% of white children in the same age group (Common Sense Media, 2013). However, these studies and figures do not take into account immigrant and first-generation Latino families.

Although data on immigration status of study participants was not accessed in this study, the school profile reported by the school district reflects 29% of the student population identified as English Learners. This figure represents a likely dominant immigrant and first-generation student status at the participating school of this study. Current research on immigrant and first-generation families report that parents tend to harbor "anxieties" about allowing their children access to the Internet and other media sources (Tripp, 2011; Lee & Baron, 2015). These parental concerns contribute to "limiting children's online opportunities" and thus, young Latinos have periodic access to the Internet and are only primarily used for homework (Tripp, 2011).

It is likely that many of the anxieties reported by Latino immigrant and first generation families are due to both safety precautions and social expectations of "La Familia." Although many of these youth have access to various media sources, it appears that immigrant and first-generation parents' approach to "parenting the internet" is balanced with efforts to use media sources for educational purposes yet at the same time protect their children from "risks of going online" (Tripp & Herr-Stephenson, 2009). Additionally, many of these children spend "little time at home unsupervised" with a parent, an older sibling or an extended family member in the household charged with child monitoring (Tripp & Herr-Stephenson, 2009). Thus, family restrictions on media use are likely more frequently implemented in immigrant and first generation households compared to children who are left unsupervised after-school for long periods of time.

Family expectations based on cultural values further appear to be a factor relating to the limited use of media sources for immigrant and first-generation families. These children tend to have family-based obligations to support the family by supervising younger siblings, attending to older family members or providing support to household chores. It appears as though levels of

family obligation expected of immigrant and first–generation youth limits the amount of screen-time in a day for these children and may be a factor as to why the study participants reported low daily usage of media sources.

In addition to the provision of family support, cohesion has long been identified as a cultural factor of Latino families (Hovey & King, 1996; Rivera, 2007; Rivera, Guarnaccia, Day, Lin, Torres & Alegria, 2008). Latino families engage in cohesion characterized by close emotional bonds that include "sharing, loyalty, reciprocity and solidarity" amongst family members (Hovey & King, 1996). According to Sabogal, Marin and Otero-Sabogal (1987), Latino family cohesion is a distinctive dimension of value amongst Hispanic families.

According to research on immigrant and first generation Latino parent restrictions on media use, social expectations of family interaction and sharing time appear to be highly valued (Tripp, 2011). Families restrict television viewing, Internet usage and mobile-media devices in an effort to continue the pursuit of family cohesion. In fact, immigrant parents report that digital media sources are not of value to the family system given their "high costs" and potential interruption to education and family interaction (Tripp & Herr-Stephenson, 2009).

Although common figures of Latino youth usage of digital media sources presents a high volume of screen-time, these findings to do not necessarily reflect immigrant and first-generation students. Based on the evidence, immigrant and first-generation youth may have more limited use of screen time due to cultural values relating to family support and cohesion. Parental restrictions of screen-time due to safety precautions as well as the social connections of "La Familia" appear to be factors that limit screen-time amongst immigrant and first-generation youth represented in the current study. Thus the discrepant reports of low screen-time usage of study participants with the current literature may be reflective of the immigrant and first-

generation status typical of the study participants and research school profile. Perhaps the relatively low use of digital media by the study participants restricted the potential association between media use and selective attention in my analyses.

Aim #2 – Natural Test Setting and Visual Selective Attention

Hypothesis #2 of the current study, that a natural test setting will enhance the visual selective attention of preadolescent digital natives, was supported. Results revealed that the setting of test administration produced a significant difference in selective and sustained attention. Students assessed in a natural environment had better performance outcomes on the TEA-Ch than students assessed in an urban school setting. Attention Restoration Theory received further support from these results, as students in a natural environment produced superior visual selective attention scores. It is surmised that exposure to a natural environment was the catalyst to reducing cognitive fatigue and restoring attention abilities tapped by the TEA-Ch assessment.

Although study results found that the administration setting produced a significant difference in visual selective and sustained attention, a specific pattern of scores over repeated administration were observed. Student abilities in sustained and selective attention and task switching were relatively consistent at pre-test and post-test when these children were assessed in a natural environment. Perhaps the natural setting at both time-points restores attention resources to a maximum ability level. These students thus achieved a "personal ceiling" from the onset of exposure to a natural environment even at time 1. As reported by Berman and colleagues (2008), benefits of the natural environment can restore attention resources due to cognitive fatigue after just a mere 10-minute exposure. Thus, the setting environment at a camp-site in a national park may have immediately facilitated attention restoration and therefore,

students were capable of achieving their maximum efficiency on these tasks at immediately at the first test administration. In comparison, there may have been a practice effect for students in the urban setting at the time 2 assessment as some improvement in scores from time 1 to time 2 was seen in these students, even though the setting by time interaction was not statistically significant.

Aim #3 – Giftedness and Visual Selective Attention

Hypothesis #3 of the current study, that a difference in attention will occur between gifted preadolescent children compared to non-gifted children when working in a naturalistic outdoor setting, had mixed results depending upon the TEA-Ch attention measure used. In relation to visual selective and sustained attention, study results indicated a main effect of giftedness on TEA-Ch test scores. In particular, non-gifted students in an urban school setting performed well below both gifted students and non-gifted students in a natural setting at pre-test administration. Thus, non-gifted students' sustained and selective attention skills seemed to benefit most from a natural environment setting for one of the TEA-Ch selective attention measures, Sky Search.

It appears as though the notion of a "personal ceiling" may be useful when evaluating these Aim #3 results. Although both gifted and non-gifted students had similar test scores in selective and sustained attention abilities when in a natural environment, their scores at both time-points were relatively consistent. It appears as though exposure to a natural environment may had have an immediate impact on attention restoration and produced superior scores in attention at both pre-test and post-test administration of the TEA-Ch.

In relation to attentional control and task switching as evaluated by the Creature Counting sub-test of the TEA-Ch, Hypothesis #3 was not confirmed and a main effect between gifted and

non-gifted students was not found. Interestingly, gifted and non-gifted students assessed in an urban environment had relatively similar attention task performance results at both pre-test and post-test. These results may be reflective of the difficulty level of the Creature Counting sub-test. This assessment in the battery of nine sub-tests was by far the most challenging assessment for children in the pilot, preliminary and main studies. Although this sub-test was the most difficult assessment, both gifted and non-gifted students had superior attentional control and task-switching performance when this sub-test was administered in a natural setting. These results indicate that a natural setting could benefit both gifted and non-gifted students when attention tasks become difficult and require more effortful attentional control strategies. Once again, these findings converge with Attention Restoration Theory, as a natural setting seems to be a valuable environment to restore attention resources to support successful completion of cognitive tasks. Comparatively, there was scant evidence to support the notion that gifted students were uniquely able to benefit from the natural environment over the course of the week at camp. In short, attending camp either particularly benefitted non-gifted students as compared to gifted students (on Sky Search), or was generally beneficial to all students in reference to an urban school setting (for the Creature Counting task).

Educational Implications

Executive function skills of attention are involved in the learning and performance in an assortment of complex cognitive and motor skills such as reading comprehension, mathematical problem solving and metacognitive strategies for task performance (DeCaro & Beilock, 2010; Flook, Smalley, Kitil, Galla, Kaiser-Greenland, Locke & Kasari, 2010). As digital natives in the US navigate the various digital media resources up to five hours a day that require attention skills, it seemed possible a shift in executive function skills would emerge in the youth

population. To what extent or in which direction digital media would have an impact on learning in relation to attention was somewhat unclear in the literature as this area of study is in early stages of development and compromised with "complexities and limitations" (Bavelier, Green, Han, Renshaw, Merzenich & Gentile, 2011).

General education. Students in general education environments have been exposed to an array of curriculum approaches by the time they reach 5th grade as schools attempt to identify the best teaching practices for achieving standardized benchmarks. Given that attention resources of executive functioning skills play a significant role in learning, school administrators must consider best practices that stimulate EF skills for students.

Altering an urban school environment into a complete natural setting is not feasible. However, educators may consider teaching approaches in outdoor education environments. Although not directly evaluated in this study, outdoor education environments may have stimulated EF skills of attention in study participants through inquiry-based learning in meaningful contextual experiences (Woodhouse & Knapp, 2000). This pedagogical practice in outdoor education values two-way dialogue that fosters authentic discovery and a depth of student understanding of the scientific process (Ardoin, Clark & Kelsey, 2013).

Nature teachers do not use published tools in their teaching sessions. Rather, they access the natural tools in the environment (e.g., face of a mountain, geology of rocks, directional flow of a river) and pose questions to stimulate critical thinking (Ardoin et. al., 2012; Woodhouse & Knapp, 2000). Outdoor education teachers consider the outdoor elements as their tools for learning and inquiry. In this process, they are likely utilizing their own critical thinking skills to develop inquiry and learning within their students. This particular pedagogical approach in conjunction with exposure to a natural setting may stimulate the attention resources of students

and apply a depth of learning not captured in the urban classroom setting.

In fact, a rite of passage for many 5th and 6th grade students nation-wide is the experience of camp in an outdoor education school. Public and private education administrators appear to recognize the social benefits of a camp experience given the widespread use of outdoor education. In fact Uhls et al. (2014) found that increased social interaction in a camp setting improved the comprehension of nonverbal emotional cues of fifth- and sixth-grade students when assessed in outdoor education environments.

It appears that while in an outdoor education setting, a student's learning potential may be heightened by the increase of selective attention and decrease of cognitive fatigue, as suggested by Attention Restoration Theory. Due to the attention benefits of natural environments upon student's task performance, educational settings in urban environments might also be minimally altered to gain the advantages of ART. An opportunity for students to experience nature in the classroom via posters of natural landscapes, indoor water features or simple artifacts of nature could possibly trigger attention restoration benefits. These simple practices might reduce cognitive fatigue, stimulate student focus and offer teachers an opportunity to engage students in experiential learning through natural resources in an urban classroom, a hypothesis worthy of further study.

Special education. Certain disabilities seen in special education are characterized by deficits in attention such as Attention Deficit/Hyperactivity Disorder (ADHD), Intellectual Disabilities (ID) and Autism Spectrum Disorder (ASD). Any instructional practice or learning environment that may lead to improvements in attention for students with these types of disabilities must be considered.

Associative learning is a learning principle that states two or more ideas, concepts,

objects or experiences reinforce each other and are linked together by the learner. Essentially, our brains connect groups of information together into one associative memory that strengthens our learning capacity through the process of association and reinforcement (Myers, 2014). For example, students may learn about multiplication as they sing a song about factors while holding multiplication flashcards. This activity would strengthen the association of the factors and their solutions and thus reinforce learning multiplication.

According to researchers Cosman and Vecera (2013), associative learning in a context where tasks are "expected to be learned" has been found to play a role in attentional control and sustained attention – deficits seen in children with ADHD, ID and ASD. In an outdoor education setting, the natural environment is the context by which learning takes place. The tools and mechanisms for learning are held directly within the context of the natural environment and thus tasks (e.g., measuring the speed of a river) may be easily learned. Essentially, linking ideas or concepts through experiential learning practices in nature can further develop associative learning benefits to students with disabilities to enhance attentional control and sustained attention.

Associative learning in natural settings may be a valuable approach to developing sustained attention in children with disabilities. In fact, Cosman & Vecera (2013) found that contexts that support associative learning improve attentional sets to overcome task distractors. Based on results of this study, a natural setting may provide an excellent context for associative learning in children with disabilities, suggesting that the benefits of natural settings or classroom enhancement for special education should be studied.

Gifted and non-gifted learners. The construct of attentional control has been further researched in tasks requiring high-level performance. Engle (2002) found that the more

attention-based resources are allocated to a specific task, the more likely success of performance will occur in "learning, problem solving and comprehension" tasks in both laboratory and real world settings. However, how do children allocate resources when tasks are quite challenging and perhaps beyond the scope of their performance abilities? Based on results of this study, even gifted children had some difficulty in completing complex tasks that required attentional control and task-switching skills when in an urban school setting. However, when gifted students were faced with a challenging task of attentional control in a natural setting, these students out-performed their gifted peers in the urban classroom.

Thus, when gifted learners are faced with challenging tasks in a natural environment, they will likely allocate cognitive strategies and resources more efficiently than their peers in an urban environment. As with the outcomes of this study, the gifted students presented with challenging tasks relating to attention control (e.g., Creature Counting) in nature, are likely capable of successful completion of higher-level task performance.

Supporting this evidence is research on divided attention of a listening task between students assessed as having high EF versus those with low EF. Students with high EF, a characteristic of gifted learners, performed better on detecting the listening task distractors elicited by researchers (Colflesh & Conway, 2007). This research is consistent with results of the current study and may have further implications for gifted and non-gifted learners in natural settings. The sub-test Sky Search DT requires test takers to complete a sustained attention task while listening to distractor sounds. Both gifted and non-gifted learners in a natural setting out-performed their peers who were administered the test in an urban classroom. Although non-gifted students may not have as high EF as gifted students, they were still capable of performing divided attention tasks at the same rate of ability as their gifted counterparts when in a nature

based setting. The attention benefits of the natural environment to non-gifted students should certainly be considered by educators and are explored below.

Limitations of This Study

A limitation of the current study is that it is a quasi-experimental design that relied on a sample of convenience. Students who attended camp were selected by their parents to participate in the current study. Although attendance to camp is cost-free, it is a purely voluntary experience and not all children attend the offered annual outdoor education trip. In short, it is difficult to determine how representative of other children this sample may be.

In relation to the study sample, detailed data on student and family English language proficiency and immigration status was not collected. This information may have elucidated further the impact of culture on digital media use and attention.

A final limitation of this study is that learning and attention may have been enhanced through the social benefits that naturally evolve in the camp environment. Teaching was conducted using alternative pedagogy with small group learning experiences. Either of these features of outdoor education (e.g., social group learning, novel pedagogy) were not extricated in this study and thus may have an unknown impact on the results of the study.

Conclusion – Outdoor Education Versus Urban Schooling

Based on the results of this study, an outdoor education environment may support the attention and executive function skills of elementary aged youth. Study results supported Attention Restoration Theory (ART) by Kaplan (1985) as further developed by Berman, Jonidas and Kaplan (2008). This integrative framework for understanding the restorative benefits of nature on cognitive fatigue was captured by the findings of this study.

Urban school environments are fraught with task demands, testing requirements and

standardized achievement expectations. Many frameworks for curriculum development in urban schools tend to be oversimplified and "fail to explore the complexity of issues facing urban schools and their communities" ("Urban Schooling", 2015). The challenges faced by students in these environments are likely mechanisms by which daily task demands and testing expectations lead to stress and eventual attention failure—the types of stressors proposed in ART to hasten cognitive fatigue.

Although it is not possible to convert school systems in urban, metropolis settings into fields of nature, environmental changes of the school environment should be considered. Given that exposure to natural settings reduces cognitive fatigue and appears to support immediate attention resources, redesigning indoor and outdoor school settings to be more hospitable should be considered. Providing an opportunity for students to engage with nature both inside the classroom and outside on the playground may improve attention during the school day and perhaps support student achievement.

References

Ahn, J. (2014). Review of it's complicated: The social lives of networked teens and the app generation: How today's youth navigate identity, dfIntimacy, and imagination in a digital world. *Journal of Children and Media, 8*(3), 313-316. Retrieved from http://search.proquest.com/docview/1614374163?accountid=14512

Anderson, R., Anderson, R., Davis, K. M., Linnell, N., Prince, C. & Razmov, V. (2007). Supporting active learning and example based instruction with classroom technology. *SIGCSE Bull.* 39, 1, 69-73. Retrieved from http://doi.acm.org/10.1145/1227504.1227338

Anderson, A. F., & Bavelier, D. (2011). Action game play as a tool to enhance perception, attention and cognition. *Computer Games and Instruction.* (pp. 307-329) IAP Information Age Publishing, Charlotte, NC. Retrieved from http://search.proquest.com/docview/909293903?accountid=14512

Ardoin, N.M., Clark, C., Kelsey, E. (2013). An exploration of future trends in environmental education research. *Environmental Education Research, 19*(4), 499-520.

Assouline, S. G., Colangelo, N., Heo, N., & Dockery, L. (2013). High-ability students' participation in specialized instructional delivery models: Variations by aptitude, grade, gender, and content area. *Gifted Child Quarterly*, *57*(2), 135-147. doi:10.1177/0016986213479654

Balderrain, Y. (2006). Distance education trends: Integrating new technologies to foster student interaction and collaboration. *Distance Education, 27(2)*, 139-153.

Barkley, R. A. (2012). *Executive functions: What they are, how they work, and why they evolved*. New York, NY US: Guilford Press. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2012-15750-

000&site=ehost-live

Bavelier, D., Achtman, R. L., Mani, M., & Föcker, J. (2012). Neural bases of selective attention in action video game players. *Vision Research, 61*, 132-143. doi:http://dx.doi.org/10.1016/j.visres.2011.08.007

Bavelier, D., Green, C. S., Han, D. H., Renshaw, P. F., Merzenich, M. M., & Gentile, D. A. (2011). Brains on video games. *Nature Reviews Neuroscience, 12*(12), 763-768. Retrieved from http://search.proquest.com/docview/1011865307?accountid=14512

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition, 50*(1-3), 7-15. Retrieved from http://search.proquest.com/docview/618527938?accountid=14512

Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science*, *19*(12), 1207-1212. doi:10.1111/j.1467-9280.2008.02225.x

Bink, M., van Nieuwenhuizen, C., Popma, A., Bongers, I. L., & van Boxtel, Geert J. M. (2014). Neurocognitive effects of neurofeedback in adolescents with ADHD: A randomized controlled trial. *Journal of Clinical Psychiatry, 75*(5), 535-542. Retrieved from http://search.proquest.com/docview/1564154316?accountid=14512

Bitner, N. & Bitner, J. (2002). Integrating Technology into the Classroom: Eight Keys to Success. Journal of Technology and Teacher Education. 10 (1), pp. 95-100. Norfolk, VA: Society for Information Technology & Teacher Education.

Buckingham, D. & Bragg, S. (2004). *Young People, Sex and the Media: the facts of life?* London:UK, Palgrave MacMillan.

Buckley, M. F. (2013). *Digital youth in digital schools: Literacy, learning and all that noise.* (Order No. AAI3542784, *Dissertation Abstracts International Section A: Humanities and Social Sciences,* Retrieved from http://search.proquest.com/docview/1435852832?accountid=14512. (1435852832; 2013-99151-094).

Calero, M. D., Belen, G. M., & Robles, M. A. (2011). Learning potential in high IQ children: The contribution of dynamic assessment to the identification of gifted children. *Learning And Individual Differences*, *21*(2), 176-181. doi:10.1016/j.lindif.2010.11.025

Cavanaugh-Blanchard, D. & Fields, R. (2014). Adult Development and Aging. Cengage: Boston.

Clark, L. S. (2009). Digital media and the generation gap: Qualitative research on US teens and their parents. *Information, Communication & Society, 12*(3), 388-407. doi:http://dx.doi.org/10.1080/13691180902823845

Coleman, L. J. (2014). "Being a teacher": Emotions and optimal experience while teaching gifted children. *Journal For The Education Of The Gifted*, *37*(1), 56-69. doi:10.1177/0162353214521495

Colflesh, G. J. H., & Conway, A. R. A. (2007). Individual differences in working memory capacity and divided attention in dichotic listening. *Psychonomic Bulletin & Review, 14*(4), 699-703. doi:http://dx.doi.org/10.3758/BF03196824

Common Sense Media (2013). Zero to Eight: Children's media use in America. Common Sense:Los Angeles. Retrieved from https://www.commonsensemedia.org/research/zero-to-eight-childrens-media-use-in-america

Cosman, J. D., & Vecera, S. P. (2013). Context-dependent control over attentional capture. *Journal of Experimental Psychology: Human Perception and Performance, 39*(3), 836-848. doi:http://dx.doi.org/10.1037/a00300273

Coyne, S. M., Padilla-Walker, L., & Howard, E. (2013). Emerging in a digital world: A decade review of media use, effects, and gratifications in emerging adulthood. *Emerging Adulthood, 1*(2), 125-137. doi:http://dx.doi.org/10.1177/2167696813479782

Dainer, K. B., Klorman, R., Salzman, L. F., Hess, D. W., Davidson, P. W., & Michael, R. L. (1981). Learning-disordered children's evoked potentials during sustained attention. *Journal of Abnormal Child Psychology, 9*(1), 79-94. Retrieved from http://search.proquest.com/docview/616516320?accountid=14512

Davidson, J. E., & Sternberg, R. J. (1984). The role of insight in intellectual giftedness. *Gifted Child Quarterly*, *28*(2), 58-64. doi:10.1177/001698628402800203

Davis, K. E. (2013). *Young people's digital lives: The impact of interpersonal relationships and digital media use on adolescents' sense of identity.* (Order No. AAI3515910, *Dissertation Abstracts International: Section B: The Sciences and Engineering,* Retrieved from http://search.proquest.com/docview/1399052947?accountid=14512. (1399052947; 2013-99100-504).

DeCaro, M. S., & Beilock, S. L. (2010). The benefits and perils of attentional control. *Effortless attention: A new perspective in the cognitive science of attention and action.* (pp. 51-73) MIT Press, Cambridge, MA. Retrieved from http://search.proquest.com/docview/754033262?accountid=14512

Dohnt, H. & Tiggemann, M. (2006). Body image concerns in young girls: The role of peers and

media prior to adolescence. *Journal of Youth & Adolescence, 35*(2), 135-145.

Dolan, M., & Lennox, C. (2013). Cool and hot executive function in conduct-disordered adolescents with and without co-morbid attention deficit hyperactivity disorder: Relationships with externalizing behaviours. *Psychological Medicine, 43*(11), 2427-2436. doi:http://dx.doi.org/10.101/S0033291712003078

Duncan, J., Emslie, H., Williams, P., Johnson, R., & Freer, C. (1996). Intelligence and the frontal lobe: The organization of goal directed behavior. Cognitive Psychology, 30(3), 257-303. doi:10.1006/cogp.1996.0008

Elliot, F.R. (1936) Memory for visual, auditory and visual-auditory material *Archives of Psychology (Columbia University), 199*, 58. Retrieved from http://search.proquest.com/docview/615050268?accountid=14512

Englander, Elizabeth K. (2011). Research Findings: MARC 2011 Survey Grades 3-12. In MARC Research Reports. Paper 2. *Massachusetts Aggression Reduction Center.* Available at: http://vc.bridgew.edu/marc_reports/2

Engle, R. W. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science, 11*(1), 19-23. doi:http://dx.doi.org/10.1111/1467-8721.00160

Felsten, G. (2009). Where to take a study break on the college campus: An attention restoration theory perspective. *Journal Of Environmental Psychology*, *29*(1), 160-167. doi:10.1016/j.jenvp.2008.11.006

Ferlazzo, F., Fagioli, S., Di Nocera, F., & Sdoia, S. (2008). Shifting attention across near and far spaces: Implications for the use of hands-free cell phones while driving. *Accident Analysis and Prevention, 40*(6), 1859-

1864. doi:http://dx.doi.org/10.1016/j.aap.2008.07.003

Flook, L., Smalley, S. L., Kitil, M. J., Galla, B. M., Kaiser-Greenland, S., Locke, J., . . . Kasari, C. (2010). Effects of mindful awareness practices on executive functions in elementary school children. *Journal of Applied School Psychology, 26*(1), 70-95. doi:http://dx.doi.org/10.1080/15377900903379125

Froese, A. D., Carpenter, C. N., Inman, D. A., Schooley, J. R., Barnes, R. B., Brecht, P. W., & Chacon, J. D. (2012). Effects of classroom cell phone use on expected and actual learning. *College Student Journal, 46*(2), 323-332. Retrieved from http://search.proquest.com/docview/1036888129?accountid=14512

Gamble, K. R., Howard, J. J., & Howard, D. V. (2014). Not just scenery: Viewing nature pictures improves executive attention in older adults. *Experimental Aging Research*, *40*(5), 513-530. doi:10.1080/0361073X.2014.956618

George, P., Dumenco, L., Dollase, R., Taylor, J. S., Wald, H. S., & Reis, S. P. (2013). Introducing technology into medical education: Two pilot studies. *Patient Education and Counseling, 93*(3), 522-524. doi:http://dx.doi.org/10.1016/j.pec.2013.04.018

Ghods-Sharifi, S., Haluk, D. M., & Floresco, S. B. (2008). Differential effects of inactivation of the orbitofrontal cortex on strategy set-shifting and reversal learning. *Neurobiology of Learning and Memory, 89*(4), 567-573. doi:http://dx.doi.org/10.1016/j.nlm.2007.10.007

Gioia, G. A., & Isquith, P. K. (2004). Ecological assessment of executive function in traumatic brain injury. *Developmental Neuropsychology, 25*(1-2), 135-158. Doi:http://dx.doi.org/10.1207/s15326942dn2501&2_8

Global WorkPlace Innovations (2011). Digital Natives: A New Generation. Johnson

Controls Automative Group:

Golden, C., Golden, C. J., & Schneider, B. (2003). Cell phone use and visual attention. *Perceptual and Motor Skills, 97*(2), 385-389. doi:http://dx.doi.org/10.2466/PMS.97.5.385-389

Greenfield, P. M. (2009). Linking social change and developmental change: Shifting pathways of human development. *Developmental Psychology, 45*(2), 401-418. doi:http://dx.doi.org/10.1037/a0014726

Greenfield, P. M. (2009). Technology and informal education: What is taught, what is learned. *Science*, *323*(5910), 69-71. doi:10.1126/science.1167190

Greenfield, P. M. (2013). The changing psychology of culture from 1800 through 2000. *Psychological Science, 24*(9), 1722-1731. Retrieved http://search.proquest.com/docview/1442383635?accountid=14512

Greenfield, P. M., Gross, E. F., Subrahmanyam, K., Suzuki, L. K., & Tynes, B. (2006). Teens on the internet: Interpersonal connection, identity, and information. *Computers, phones, and the internet: Domesticating information technology.* (pp. 185-200) Oxford University Press, New York, NY. Retrieved from http://search.proquest.com/docview/621780762?accountid=14512

Gross, E. F. (2004). Adolescent internet use: What we expect, what teens report. *Journal of Applied Developmental Psychology, 25*(6), 633-649. doi:http://dx.doi.org/10.1016/j.appdev.2004.09.005

Gulchak, D. J. (2008). Using a mobile handheld computer to teach a student with an emotional and behavioral disorder to self-monitor attention. *Education & Treatment of Children, 31*(4), 567-581. doi:http://dx.doi.org/10.1353/etc.0.0028

Hanten, G., & Levin, H. S. (2008). Executive functioning in children with traumatic brain injury in comparison to developmental ADHD. *Cognitive neurorehabilitation: Evidence and application (2nd ed.).* (pp. 487-506) Cambridge University Press, New York, NY. Retrieved from http://search.proquest.com/docview/621598256?accountid=14512

Hedden, T., & Gabrieli, J. D. E. (2010). Shared and selective neural correlates of inhibition, facilitation, and shifting processes during executive control. *NeuroImage, 51*(1), 421-431. doi:http://dx.doi.org/10.1016/j.neuroimage.2010.01.089

Helder Babcock, E. A. (2009). *Controlling distraction on the internet: An investigation into the mechanisms involved in minimizing the influence of internet ads on an information searching task.* (Order No. AAI3331923, *Dissertation Abstracts International: Section B: The Sciences and Engineering,* , 5801. Retrieved from http://search.proquest.com/docview/622072048?accountid=14512. (622072048; 2009-99060-489).

Hester, R., Lubman, D. & Yucel, M. (2010). The role of executive control in human drug addiction. *Behavioral neuroscience of drug addiction,* 301-318. Springer:New York

Hobson, C. W., Scott, S., & Rubia, K. (2011). Investigation of cool and hot executive function in ODD/CD independently of ADHD. *Journal of Child Psychology and Psychiatry, 52*(10), 1035-1043. doi:http://dx.doi.org/10.1111/j.1469-7610.2011.02454.x

Holmberg, N., Sandberg, H., & Holmqvist, K. (2014). Advert saliency distracts children's visual attention during task-oriented internet use. *Frontiers in Psychology, 5* doi:http://dx.doi.org/10.3389/fpsyg.2014.00051

Hong, K. H. (2010). *L2 teachers' experience of CALL technology education and the use of computer technology in the classroom: The case of franklin county, ohio* (Order No. AAI3375773). Available From PsycINFO. (742989798; 2010-99070-066). Retrieved from http://search.proquest.com/docview/742989798?accountid=14512

Hongwanishkul, D., Happaney, K. R., Lee, W. S. C., & Zelazo, P. D. (2005). Assessment of hot and cool executive function in young children: Age-related changes and individual differences. *Developmental Neuropsychology, 28*(2), 617-644. doi:http://dx.doi.org/10.1207/s15326942dn2802_4

Hovey, J. & King, C. (1996). Acculturative stress, depression, and suicidal ideation among immigrant and second-generation latino adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry, 35*(9), 1182-1193. doi:10.1097/00004583-199609000-00016

Hubert-Wallander, B., Green, C. S., Sugarman, M., & Bavelier, D. (2011). Changes in search rate but not in the dynamics of exogenous attention in action videogame players. *Attention, Perception, & Psychophysics, 73*(8), 2399-2412. doi:http://dx.doi.org/10.3758/s13414-011-0194-7

Kaplan, R. & Kaplan, S. (1982). *Humanscape: Environments for People*. Ann Arbor, Mich.: Ulrich's Books. ISBN 0-914004-49-2.

Kenan-Smalls, Y. (2011). *Diversity and inclusion in information technology from an age perspective: Motivating and managing information technology professionals across multiple generations in the workforce.* (Order No. AAI3443662, *Dissertation Abstracts International Section A: Humanities and Social Sciences,* , 1366. Retrieved from http://search.proquest.com/docview/909298363?accountid=14512. (909298363; 2011-

99190-271).

Kiernan, P. J., & Aizawa, K. (2004). Cell phones in task based learning: Are cell phones useful language learning tools? *ReCALL: Journal of Eurocall, 16*(1), 71-84. doi:http://dx.doi.org/10.1017/S0958344004000618

Kim, G., & Lee, J. (2011). The effect of search condition and advertising type on visual attention to internet advertising. *Cyberpsychology, Behavior, and Social Networking, 14*(5), 323-325. doi:http://dx.doi.org/10.1089/cyber.2010.0075

Landhuis, C. E., Poulton, R., Welch, D., & Hancox, R. J. (2007). Does television viewing lead to attention problems in adolescence? results from a prospective longitudinal study. *Pediatrics, 120*(3), 532-537. doi:http://dx.doi.org/10.1542/peds.2007-0978

Lee, J. & Baron, B. (2015). *Aprendiendo en casa: Media as a resouce for learning among Hispanic- Latino Families*. A report of the Families and Media Project. New York: The Joan Ganz Cooney Center at Sesame Workshop.

Levin, T., & Wadmany, R. (2006). Listening to students' voices on learning with information technologies in a rich technology-based classroom. *Journal of Educational Computing Research, 34*(3), 281-317. doi:http://dx.doi.org/10.2190/CT6Q-0WDG-CDDP-U6TJ

Lipowski, Z.J. (1975). "Sensory and information inputs overload: Behavioral effects". *Comprehensive Psychiatry* **16** (3): 199–221. doi:10.1016/0010-440X(75)90047-4. ISSN 0010-440X

Lorch, E. P., & Castle, V. J. (1997). Preschool children's attention to

television: Visual attention and probe response times. *Journal of Experimental Child Psychology, 66*(1), 111-127. Retrieved from http://search.proquest.com/docview/619095943?accountid=14512

Lumas, K. (2006). *Pilot study on trace detection technology and the impact of false positive test results for individuals in the commercial transportation industry.* (Order No. AAI3216022, *Dissertation Abstracts International: Section B: The Sciences and Engineering,* , 2233. Retrieved from http://search.proquest.com/docview/621574024?accountid=14512. (621574024; 2006-99020-260).

Manago, A. M., & Greenfield, P. M. (2011). The construction of independent values among maya women at the forefront of social change: Four case studies. *Ethos, 39*(1), 1-29. doi:http://dx.doi.org/10.1111/j.1548-1352.2010.01168.x

Maynard, A., Greenfield, P., Childs, C. (2003). Historical changes, cultural learning and cognitive representation in Zinacantec Maya children. Cognitive Development

McCabe, M. & Ricciardelli, L. (2001). Parent, peer and media influences on body image and strategies to both increase and decrease body size among adolescent boys and girls, *Adolescence*, vol. 36, no. 142, Summer, pp. 225-240.

McCauley Ohannessiann, C. (2009). Media use and adolescent psychological adjustment: An examination of gender differences. *Journal of Child and Family Studies, 18*(5), 582-593).

McCollister, K., & Sayler, M. F. (2010). Lift the Ceiling: Increase Rigor with Critical Thinking Skills. *Gifted Child Today*, *33*(1), 41-47.

"Media and Children." *American Academy of Pediatrics.* Accessed August 24, 2015.

https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/pages/media-and children.aspx

Media Learning Clearinghouse (2013). Media use statistics: Resources of media habits on children, youth and adults. Retrieved from http://www.frankwbaker.com/mediause.htm

Meyers, D. (2014). Exploring Psychology. Cengage:Boston.

Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience, 24*, 167-202. doi:http://dx.doi.org/10.1146/annurev.neuro.24.1.167

Miller, C. J., Marks, D. J., Miller, S. R., Berwid, O. G., Kera, E. C., Santra, A., & Halperin, J. M. (2007). Brief report: Television viewing and risk for attention problems in preschool children. *Journal of Pediatric Psychology, 32*(4), 448-452. doi:http://dx.doi.org/10.1093/jpepsy/jsl035

Mistry, Minkovitz, Strobino & Borzekowski (2007). Children's television exposure and behavioral and social outcomes: Does timing of exposure matter? *Pediatrics, 120*(4) 762-769.

McGillivray, D. (2014). Digital cultures, acceleration and mega sporting event narratives. *Leisure Studies, 33*(1), 96-109 doi:http://dx.doi.org/10.1080/02614367.2013.841747

Moriguchi, Y., & Hiraki, K. (2013). Prefrontal cortex and executive function in young children: A review of NIRS studies. *Frontiers in Human Neuroscience, 7* doi:http://dx.doi.org/10.3389/fnhum.2013.00867

National Center for Learning Disabilities (2013). Understood: For learning and

attention issues. Retrieved from http://www.understood.org/en

Nuttall, J., Edwards, S., Lee, S., Mantilla, A., & Wood, E. (2013). The implications of young children's digital-consumerist play for changing the kindergarten curriculum. *Cultural-Historical Psychology, 2*, 54-63. Retrieved from http://search.proquest.com/docview/1542019403?accountid=14512

Peterson, J. S. (2013). School counselors' experiences with a summer group curriculum for high-potential children from low-income families: A qualitative study. *Professional School Counseling*, *16*(3), 194-204.

Pew Research Center (2011). Internet and American life project. Retrieved from http://www.pewinternet.org/2014/11/12/introduction-18/

Pfeiffer, Steven I., and Aimee Yermish. 2014. "Gifted children." In *Translating psychological research into practice*, 57-64. New York, NY, US: Springer Publishing Co, 2014. *PsycINFO*, EBSCO*host* (accessed February 23, 2015).

Prencipe, A., Kesek, A., Cohen, J., Lamm, C., Lewis, M. D., & Zelazo, P. D. (2011). Development of hot and cool executive function during the transition to adolescence. *Journal of Experimental Child Psychology, 108*(3), 621-637. doi:http://dx.doi.org/10.1016/j.jecp.2010.09.008

Prensky, M. (2001). On the horizon: Digital natives, digital immigrants. MCB University Press, 9(5), 1-6.

Richardson, J. M. (2014). Powerful devices: How teens' smartphones disrupt power in the theatre, classroom and beyond. *Learning, Media and Technology, 39*(3), 368-385. doi:http://dx.doi.org/10.1080/17439884.2013.867867

Rivera, F., Guarnaccia, P., Day, N., Lin, J., Torres, M. & Alegria, M. (2008). Family cohesion

and its relationship to psychological distress among latino groups. *Hispanic Journal of Behavioral Science, 30*(3), 357-378.

Rogers, K. B. (1986). *Do the Gifted Think and Learn Differently? A Review of Recent Research and Its Implications for Instruction*.

Rosen, L. D., Mark Carrier, L., & Cheever, N. A. (2013). Facebook and texting made me do it: Media-induced task-switching while studying. *Computers in Human Behavior, 29*(3), 948-958. doi:http://dx.doi.org/10.1016/j.chb.2012.12.001

Rossi, A. F., Pessoa, L., Desimone, R., & Ungerleider, L. G. (2009). The prefrontal cortex and the executive control of attention. *Experimental Brain Research, 192*(3), 489-497. doi:http://dx.doi.org/10.1007/s00221-008-1642-z

Rowe, E. W., Dandridge, J., Pawlush, A., Thompson, D. F., & Ferrier, D. E. (2014). Exploratory and confirmatory factor analyses of the WISC-IV with gifted students. *School Psychology Quarterly*, *29*(4), 536-552. doi:10.1037/spq0000009

Russell, R., A. Guerry, P. Balvanera, R. Gould, X. Basurto, K. Chan, S. Klain, J. Levine, and J. Tam (2013). Human Nature: How Knowing and Experiencing Nature Affect Well-Being. *Annual Review of Environment and Resources 38*, 473-502. doi:http//annualreviews.org/doi/abs/10.1146-012312-110838

Sabogal, F., Marin, G., Otero-Sabogal, R. (1987). Hispanic Familism and Acculturation: What Changes and What Doesn't? *Hispanic Journal of Behavioral Science, 9*(4), 397-412.

Setliff, A. E., & Courage, M. L. (2011). Background television and infants' allocation of their attention during toy play. *Infancy, 16*(6), 611-639. doi:http://dx.doi.org/10.1111/j.1532-7078.2011.00070.x

Shalev, L., Tsal, Y., & Mevorach, C. (2007). Computerized progressive

attentional training (CPAT) program: Effective direct intervention for children with ADHD. *Child Neuropsychology, 13*(4), 382-388. doi:http://dx.doi.org/10.1080/09297040600770787

Shaw, R., Grayson, A., & Lewis, V. (2005). Inhibition, ADHD, and computer games: The inhibitory performance of children with ADHD on computerized tasks and games. *Journal of Attention Disorders, 8*(4), 160-168. doi:http://dx.doi.org/10.1177/1087054705278771

Shaw, R., & Lewis, V. (2005). The impact of computer-mediated and traditional academic task presentation on the performance and behaviour of children with ADHD. *Journal of Research in Special Educational Needs, 5*(2), 47-54. doi:http://dx.doi.org/10.1111/J.1471-3802.2005.00041.x

Sim, J. & Reid, R. (1999). Statistical inference by confidence intervals: Issues of interpretation and utilization. *Journal of the American Physical Therapy Association, 79*(2), 186-195.

Simons, R. F., Detenber, B. H., Cuthbert, B. N., Schwartz, D. D., & Reiss, J. E. (2003). Attention to television: Alpha power and its relationship to image motion and emotional content. *Media Psychology, 5*(3), 283-301. doi:http://dx.doi.org/10.1207/S1532785XMEP0503_03

Smutny, J. F. (2011). Challenge Your Top Students. *Instructor*, *121*(3), 30-35.

Solomonidou, C., Garagouni-Areou, F., & Zafiropoulou, M. (2004). Information and communication technologies (ICT) and pupils with attention deficit hyperactivity disorder (ADHD) symptoms: Do the software and the instruction method

affect their behavior? *Journal of Educational Multimedia and Hypermedia, 13*(2), 109-128. Retrieved from http://search.proquest.com/docview/620425498?accountid=14512

Spero, I., & Stone, M. (2004). Agents of change: How young consumers are changing the world of marketing. *Qualitative Market Research: An International Journal, 7*(2), 153-159. Retrieved from http://search.proquest.com/docview/620851943?accountid=14512

Sternberg, R. J. (2011). From intelligence to leadership: A brief intellectual autobiography. *Gifted Child Quarterly*, *55*(4), 309-312. doi:10.1177/0016986211421872

Sweetland, J. D., Reina, J. M., & Tatti, A. F. (2006). WISC-III Verbal/Performance discrepancies among a sample of gifted children. *Gifted Child Quarterly*, *50*(4), 7-10. doi:10.1177/001698620605000102

Swing, E. L., Gentile, D. A., Anderson, C. A., & Walsh, D. A. (2010). Television and video game exposure and the development of attention problems. *Pediatrics, 126*(2), 214-221. doi:http://dx.doi.org/10.1542/peds.2009-1508

Subrahmanyan & Smahel (2012). Digital Youth: The role of media in development. Springer Publishers:New York/London.

Sung, Y., Chang, K., & Huang, J. (2008). Improving children's reading comprehension and use of strategies through computer-based strategy training. *Computers in Human Behavior, 24*(4), 1552-1571. doi:http://dx.doi.org/10.1016/j.chb.2007.05.009

Tetloff, M., Hitchcock, L., Battista, A., & Lowry, D. (2014). Multimodal

composition and social justice: Videos as a tool of advocacy in social work pedagogy. *Journal of Technology in Human Services, 32*(1-2), 22-38. doi:http://dx.doi.org/10.1080/15228835.2013.857284

Tremblay, E. A. (2010). Educating the mobile generation—Using personal cell phones as audience response systems in post-secondary science teaching. *Journal of Computers in Mathematics and Science Teaching, 29*(2), 217-227. Retrieved from http://search.proquest.com/docview/754058749?accountid=14512

Tripp, L. (2011). 'The computer is not for you to be looking around, it is for schoolwork': Challenges for digital inclusion as Latino immigrant families negotiate children's access to the Internet. *New Media & Society,13*, 552-567, doi:10.1177/1461444810375293

Tripp, L. & Herr-Stephenson, R. (2009). Making Access Meaningful: Latino Young People Using Digital Media at Home and at School. *Journal of Computer-Mediated Communication, 14*(4), 1190–1207.

Troshynski, E. I. (2012). *Surveillance technology and the transformation of criminal justice: Monitoring sex offenders with GPS technology.* (Order No. AAI3478029, *Dissertation Abstracts International Section A: Humanities and Social Sciences,* , 361. Retrieved from http://search.proquest.com/docview/1041001655?accountid=14512. (1041001655; 2012-99130-392).

Tsuchida, A., & Fellows, L. K. (2009). Lesion evidence that two distinct regions within prefrontal cortex are critical for n-back performance in humans. *Journal of Cognitive Neuroscience, 21*(12), 2263-2275. doi:http://dx.doi.org/10.1162/jocn.2008.21172

Tucha, L., Tucha, O., Walitza, S., Sontag, T. A., Laufkötter, R., Linder, M., &

Lange, K. W. (2009). Vigilance and sustained attention in children and adults with ADHD. *Journal of Attention Disorders, 12*(5), 410-421. doi:http://dx.doi.org/10.1177/1087054708315065Viacom Digital Media Group (2013).

Uhls, Y., Michikyan, M., Garcia, D., Morris, J., Small, G., Greenfield, P.M. (2014). Five days at outdoor education camp without screens improves preteen skills with nonverbal emotion cues. *Computers in Human Behavior, 39,* 387-392.

doi:10.1016/j.chb.2014.05.036

"Urban Schooling." *UCLA Graduate School of Education and Information Studies – Urban Schooling Division*. Accessed July 23, 2015. http://gseis.ucla.edu/education/academic-programs/urban-schooling/

Vakil, E., & Hoffman, Y. (2004). Dissociation between two types of skill learning tasks: The differential effect of divided attention. *Journal of Clinical and Experimental Neuropsychology, 26*(5), 653-666. doi:http://dx.doi.org/10.1080/13803390490504335

Van den Bulck, J. & Van den Bergh, B. (2000). The Influence of Perceived Parental Guidance Patterns on Children's Media Use: Gender Differences and Media Displacement. *Journal of Broadcasting and Electronic Media, 44*(3), 329-348.

Vannatta, R. A., & Nancy, F. (2004). Teacher dispositions as predictors of classroom technology use. *Journal of Research on Technology in Education, 36*(3), 253-271. doi:10.1080/15391523.2004.10782415

Vodanovich, S., Sundaram, D., & Myers, M. (2010). Digital natives and ubiquitous information systems. *Information Systems Research, 21*(4), 711-723. doi:http://dx.doi.org/10.1287/isre.1100.0324

Wasserstein, J., & Denckla, M. B. (2009). *ADHD and learning disabilities in adults: Overlap with executive dysfunction* American Psychiatric Publishing, Inc., Arlington, VA. Retrieved from http://search.proquest.com/docview/621694801?accountid=14512

Woodhouse, J. & Knapp, C. (2000). Place-Based Curriculum and Instruction: Outdoor and Environmental Education Approaches. *Eric Digest*, http://www.ericdigests.org/2001-3/place.htm

Wilkinson, N., Ang, R. P., & Goh, D. H. (2008). Online video game therapy for mental health concerns: A review. *International Journal of Social Psychiatry, 54*(4), 370-382. doi:http://dx.doi.org/10.1177/0020764008091659

Wise, S., Greenwood, J., & Davis, N. (2011). Teachers' use of digital technology in secondary music education: Illustrations of changing classroom. *British Journal of Music Education, 28*(2), 117-134. doi:http://dx.doi.org/10.1017/S0265051711000039

Xu, H., Zhang, D., Ouyang, M., & Hong, B. (2013). Employing an active mental task to enhance the performance of auditory attention-based brain–computer interfaces. *Clinical Neurophysiology, 124*(1), 83-90. doi:http://dx.doi.org/10.1016/j.clinph.2012.06.004

Yuan, P., & Raz, N. (2014). Prefrontal cortex and executive functions in healthy adults: A meta-analysis of structural neuroimaging studies. *Neuroscience and Biobehavioral Reviews, 42*, 180-192. doi:http://dx.doi.org/10.1016/j.neubiorev.2014.02.005

Zelazo, P. D., & Carlson, S. M. (2012). Hot and cool executive function in childhood and adolescence: Development and plasticity. *Child Development Perspectives, 6*(4), 354-360. Retrieved from http://search.proquest.com/docview/1269433419?accountid=14512

Zelazo, P. D., & Müller, U. (2002). Executive function in typical and atypical

development. *Blackwell handbook of childhood cognitive development.* (pp. 445-469) Blackwell Publishing, Malden. doi:http://dx.doi.org/10.1002/9780470996652.ch20

Zelazo, P.D., Qu, L. & Müller, U. (2005). Hot and cool aspects of executive function: Relations in early development. Eds., Schneider, Shumann & Sodian. Erlbaum:New York.

Zorilla, M. (2011). Video games and gender: Game representation, gender effects, differences in play, and player representation. Retrieved from http://radford.edu/~mzorrilla2/thesis/index.html, Radford University Press.