IS TELEVISION THE NEW STIMULANT DRUG? PHYSIOLOGICAL RESPONSES TO VIDEO CLIPS IN PARTICIPANTS WITH ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

by

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ABSTRACT

Attention-Deficit/Hyperactivity Disorder (AD/HD) is a disorder characterized by an inability to focus attention, exert self-control, and succeed in an academic or career environment. Stimulant medications are typically used to treat AD/HD but they can have unpleasant and even dangerous side effects. Drawing from several communication and psychological theories on limited capacity for information processing and the self-regulation of undesirable behaviors, this dissertation examined whether fast-paced, highly aversive or appetitive video combined with glucose could improve recall in participants with and without AD/HD.

20 non-referred and 20 AD/HD participants were recruited and physiological data, self-report data, and signal detection responses were recorded and analyzed for trends in physiological responses and accuracy of recall. Results from the experiment indicate that glucose has a significant effect on recall, and figures indicate the pacing and valence attributes that are most effective for recall in AD/HD individuals. Data from this dissertation may be used as a model for the development of educational videos targeted to enriching the academic lives of AD/HD individuals. Data from the survey portion of the study is also indicative of the prevalence of medicated AD/HD in the college population.

DEDICATION

To everyone who laughed, cried, commiserated and cheered along with me. Without you I would be lost.

LIST OF ABBREVIATIONS AND SYMBOLS

d'	Sensitivity index: The separation and spread of a set of signal detection responses
df	Degrees of freedom: number of values free to vary after certain restrictions have been placed on the data
F	Fisher's *F* ratio: A ration of two variances
M	Mean: the sum of a set of measurements divided by the number of measurements in the set
η^2	Eta-squared: A measure of effect size
p	Probability associated with the occurrence under the null hypothesis of a value as extreme as or more extreme than the observed value
t	Computed value of *t* test
μS	Microsiemens: A measure of conductivity
<	Less than
=	Equal to

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CHAPTER 1

INTRODUCTION

Attention Deficit/Hyperactivity Disorder (AD/HD) is a learning disorder characterized by a distinctive inability to focus attention or maintain self-control over voluntary behavior, especially in classroom settings (Barkley, 2003). This disorder is strongly associated with poor grades, poor skills in math and reading, lower standardized test scores and higher rates of failure and retention (Loe & Feldman, 2007). For this reason, the treatment of AD/HD has been a goal for researchers in many fields. AD/HD symptoms have been successfully managed with the use of stimulant drug therapies, but these therapies can result in unpleasant side effects, vulnerability to illicit drug use, and even death (Gould, et al.., 2009). While parental training and self-control instruction have both been proposed as a non-stimulant drug treatment of this disorder, these have not proven significantly effective in managing AD/HD symptoms in classroom setting (Horn, Ialongo, Greenberg, Packard, & Smith-Winberry, 1990).

While many studies have indicated the negative impact that television has on educational success and attentional abilities (i.e. Levine & Waite, 2000), it may be possible that television could serve as a vehicle for delivery of educational information to students suffering from AD/HD. A correlation between television viewing and AD/HD has been found, but empirical data also indicates that there is not a causal relationship present (Stevens & Mulsow, 2006). The correlation, then, could serve as an indication that some aspect of this medium is particularly enjoyable for AD/HD individuals, making it an ideal delivery system for educational programming.

Attentional abilities, often the DV in studies on the media and children, can be defined as the ability to focus attention on a particular task in order to successfully and satisfactorily complete it. This can be measured in different ways, especially between fields. In psychology, for example, attentional ability can be measured using mundane and repetitive tasks and observing the number of errors made. For example, participants may be asked to read a 750 word paper and circle all of the letter "e"s they see. Other studies may use parent and teacher evaluations of attention and success at home and in the classroom (e.g. Levine & Waite, 2000). For the purposes of research, therefore, attentional ability can be operationally defined as the application of the focus of cognitive resources to boring or monotonous tasks.

Cognitive psychology research has been preoccupied with how the brain focuses on, attends to, and stores information about environmental stimuli. Limited capacity theory (Kahneman, 1973) and its communications counterpart the limited capacity model for motivated mediated message processing (LC4MP) (Lang, 2000) both suggest that the brain has a finite amount of resources that can be used for cognitive processes. These resources are consumed by

Like limited capacity theory and LC4MP, self-regulation theory asserts that the resources used to exert willpower over one's actions and responses are finite and are consumed by these efforts. Studies on self-regulation, however, have proposed that these resources can be replenished. One popular method is increasing blood sugar by providing individuals with glucose, which has shown to increase their ability to make better choices, exert more self-control, and perform better on inhibiting behavior tests.

This dissertation draws from several psychological and communications theories, as well as research on AD/HD and attentional outcomes related to media viewing, and tests several components of these theories in an effort to determine if mediated messages combined with glucose may be a suitable substitute for stimulant medications in special instances. Through a psychophysiological experiment where pacing and valence of videos are controlled and encoding is measured by signal detection tests, the potential of glucose and media to provide an alternative to stimulant medication is examined.

CHAPTER 2

ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

Although there are those who claim that AD/HD was "invented" for DSM-III (the first version of the DSM that included an independent description of Attention Deficit Disorder [ADD]) (Baughman, 2000) there are accounts throughout history that describe the inability to focus attention or exert self-control to the detriment of the individual that are hallmarks of the disorder. Traditionally the first written reports of what would be classified as AD/HD are attributed to a London pediatrician named George F. Still, who in 1902 was among the first to seriously consider and discuss the behavior of children under his care as a potential medical condition (Barkley, 1990). An even earlier account exists, however, in the 1798 notes of another physician named Alexander Crichton (Palmer & Finger, 2001). In his *Inquiry,* a chapter entitled *On Attention and its Diseases* is where what is likely the first documented identification of the inability of certain individuals to dedicate their attention to any single task or object for extended periods of time. To date, this is the oldest proposal of AD/HD as a legitimate disorder.

After Crichton's *Inquiry*, very little is written or discussed regarding AD/HD for another 100 years, until the more famous written accounts of George F. Still at the turn of the 20th century. His 1902 lectures to the Royal College of Physicians are where more traditional historical accounts of the recognition of AD/HD begin, and after the publication of these lectures the interest in this behavior grew in medical and scientific communities (Palmer & Finger, 2001). Tredgold (1908) was a strong supporter of the possibility that the disorder may have stemmed from early brain damage in patients. This potential cause of unfocused attention and poor self-control would be further supported after an epidemic of encephalitis struck during 1917 and 1918, with young survivors exhibiting the behaviors that were now attributed to the disorder (Palmer & Finger, 2001). This led to increased examination of the brain as a cause for the behavior, as well as referring to this disorder as 'minimal brain dysfunction' (MBD) during the 1950s and 1960s.

In 1940, Dr. Charles Bradley and a registered nurse under his practice published a paper in which he noted that amphetamine salts were effective in improving the academic performance of children with "nuero-psychiatric disorders" (Bradley & Bowen, 1940, p. 782). In his study, he noted that the stimulant had a calming effect on the nineteen schoolchildren who were treated with it and resulted in better self-control and better performance on classroom activities. Although amphetamine salts were not a new concept in the treatment of many disorders, it was the first time that the idea of using a stimulant to treat overactive behavior was applied with success, and the first time these stimulants were used for the purpose of improving the academic performance of children. It was a groundbreaking study that led to many more and to stimulant medication treatment methods still used today (discussed in detail later in this chapter).

Eventually MBD would be reclassified as "Attention Deficit Disorder" (ADD) when it first appeared in the DSM-III in 1980, and adjusted later to Attention Deficit/Hyperactivity Disorder (Palmer & Finger, 2001). Throughout the 1980s and 1990s, reported prevalence of the disease appeared to grow, although estimates are difficult to obtain due to the different diagnostic approaches available (LeFever, Arcona & Antonuccio, 2003). With the increase in cases came an increase in stimulant drug therapy to address the disorder's symptoms, and an increase in concern over what long-term effects stimulant drug use during childhood may have. As a visibly present and ethically questionable cause, many authors and researchers began to use these stimulant therapies to demonstrate a larger societal issue – the over-diagnosis and over-prescription of what were seen as "fake" disorders (e.g. DeGrandpre, 1999; Vatz & Weinberg, 1993).

AD/HD's transformation from a barely noticed disorder to a hotbed of controversy makes it an interesting and relevant area of study as alternatives to stimulant drug therapy are sought and causes of the disorder are still explored. Although there are still critics to the "legitimacy" of the disorder and the ethics of treating children with potentially harmful medication, in 2007 the United States Congress declared September 7th as National Attention Deficit Disorder Awareness Day (Designating, 2007), cementing the disorder's recognition as a recognized concern for society.

Overview and Symptoms of AD/HD

Criteria for the Diagnosis of AD/HD

According to the Diagnostic and Statistical Manual of Mental Disorders IV Text Revision (DSM-IV-TR), AD/HD is defined as an ongoing pattern of inability to focus attention and/or hyperactive-impulsive behavior that is more often displayed and more severe than behaviors observed in non-referred member at a comparable level of development (American Psychiatric Association, 2000). Essentially these behaviors are a marked tendency of the AD/HD individual to be highly active, even in inappropriate places and situations, and to lack a degree of self-control over impulses. AD/HD children show a vexing lack of behavioral adjustment as a result of reward promise or talk therapy, and it is hypothesized that there is a dysfunction in the reward center of AD/HD patients.

Additionally, the DSM-IV-TR advises that individuals should not be considered sufferers of the disorder if symptoms were not present before seven years of age. The disorder must have demonstrable negative impact on life in two of the sufferer's settings (i.e. home and school), to ensure that elements of a certain environment are not the cause of the inattention, for example a boring teacher. These two delineations are important in identifying the disorder as the cause of behavioral issues and not another more recent development of another psychological or physical disorder (Solanto, Arnsten & Castellanos, 2001).

To be diagnosed with AD/HD, patients must exhibit at least one of two sets of behaviors, but may exhibit both sets. Six or more of a list of inattention symptoms must be met in order for the behavior to be diagnosed as AD/HD. If six of these symptoms are not persistent, a child may still be diagnosed with AD/HD if they consistently display one of six symptoms of hyperactivity and/or impulsivity. These behaviors are listed in Table 2.1 (p. 8).

Studies have supported the accuracy of these criteria as an objective means of assessing whether or not a patient is suffering from AD/HD. A study by Porrino, Rapport, Behar, Sceery, Ismond and Bunney (1983) affixed monitors to hyperactive and control children, which continuously recorded their activity for seven days. AD/HD children were significantly more active than their non-referred cohort in most activities, including during sleep. Impulse control issues have been demonstrated in many different studies, with AD/HD individuals performing more poorly on many tasks associated with impulse control including continuous performance tests (CPT) (Corkum & Seigel, 1993) and go/no go Tasks (Casey et al.., 1997).

H_1: Diagnosed participants will have a higher rate of false alarms than non-referred participants during signal detection tests.

Table 2.1
*Diagnostic List of AD/HD Behaviors**

Inattention

1. Fails to pay attention to details or makes careless mistakes in school, at work, or during other activities.
2. Has difficulty maintaining attention in household tasks or play activities.
3. Does not appear to listen when directly addressed.
4. Does not follow through on tasks and fails to follow instructions.
5. Has difficulty with organization of tasks and activities.
6. Avoids engaging in tasks that will require sustained mental effort.
7. Frequently loses important objects necessary for tasks or activities.
8. Easily distracted by extra stimuli.
9. Forgetful throughout daily activities.

Hyperactivity

1. Fidgets or squirms in seat.
2. Has difficulty remaining seated in situations where it is expected.
3. Runs or climbs when inappropriate (in adolescents or adults this may be reported as feelings of restlessness).
4. Has difficulty participating in leisurely activities quietly.
5. Frequently "on the go".
6. Talks excessively.

Impulsivity

1. Blurts out answers before waiting for question to be completed.
2. Finds it difficult to wait for a turn.
3. Frequently interrupts others.

**adapted from DSM-IV-TR (APA, 2000)*

In females, the symptoms of AD/HD may manifest in a slightly different fashion. Whereas male children with the disorder tend to act in hyperactive and aggressive manners, female children tend to internalize symptoms, resulting in low self-esteem, forgetfulness, disorganization, anxiety, and depression (Quinn, 2005).

While the DSM-IV-TR recommends symptoms be observed prior to seven years of age, research on AD/HD indicates that nine years of age may be more accurate for combined type and nine to fourteen years a better gauge for the inattentive type (subtypes will be discussed in more depth in the next section) (Applegate, et al., 1997; Barkley & Biederman, 1997). This suggests that many legitimate cases are not diagnosed for failing to meet this age of onset criteria, and Barkley and Biederman (1997) reject this age limitation as arbitrary and unsupported by research on the disorder. Another concern with the current criteria is that several items seem to refer to young patients only and are harder to apply to adults suffering with AD/HD (Bell, 2010).

At the time this dissertation was written, the latest version of the DSM, the DSM-V, was anticipated in 2013 (APA, 2010). Potential changes to the diagnostic criteria for AD/HD have been suggested by several sources, and include the possibility of raising the age of onset criteria (Finn, 2009) and possibly eliminating subtypes discussed in the DSM-IV-TR (Castellanos, 2009). These are only proposed changes, however, and the DSM-IV-TR diagnostic criteria were referenced for the duration of this study and dissertation.

Methods of Diagnosis

There is no single accepted means of diagnosing AD/HD during any stage of life. Generally a diagnosis is the result of careful examination of the individual's life, performance, and behaviors, as well as evaluations from family, educators, or employers (Solanto, Arnsten & Castellanos, 2001). One key concept in the diagnosis of individuals is the level of impairment presented as a result of symptoms (Bell, 2010). A subthreshold diagnosis results when a patient fails to meet six of the required criteria for diagnosis but still exhibits many of the symptoms of AD/HD, including impairment in some area of their lives. According to one study, those who fell into the subthreshold category of diagnosis were more impaired than the general undiagnosed population, although not nearly as much as those who met the diagnostic criteria for AD/HD (Faraone, et al.., 2006).

In order to achieve a comprehensive picture of the symptoms and their impact on a patient's lifestyle, several methods of diagnosis may be employed by physicians and clinicians. To establish the correct symptoms and impairments are present, and to eliminate other neurological or health issues are the cause of these behaviors, several approaches must be taken

(Goldman, Genel, Bezman & Slanetz, 1998). An initial interview with adult caregivers gives the diagnostician an idea of the complaints involved. An examination of the mental and medical health of the child would then be conducted to ensure no ailments are present. Cognitive assessments of ability and achievement should then be used in conjunction with parent and teacher AD/HD scale ratings, and objective classroom performance evaluations such as report cards and language assessments. Although abnormalities have been noted using magnetic resonance imaging (MRI) of the brain activity of those with AD/HD, they are not typically used to diagnose AD/HD and they have not been used as a definitive means of determining a diagnosis (Castellanos, et al.., 1996).

Diagnosing an adult with AD/HD can be more difficult than the traditional childhood diagnosis. According to the DSM-IV-TR criteria, the symptoms would have to be present before adulthood (APA, 2000). Finding information in the traditional ways, such as parent and teacher ratings, would no longer be a realistic or effective means of obtaining important information. One solution to this problem is the self-report and recall of symptoms by the patient. Although this method could present problems in terms of accuracy and validity, a study by Murphy and Schachar (2000) indicated that adult recollections were highly correlated with outside observers' recollections and reports. Another study, however, refuted Murphy and Schachar's (2000) claims, noting that many of the symptom complaints are not exclusive to AD/HD and that accounts could be highly influenced and unreliable (Suhr, Zimak, Buelow & Fox, 2009). The ability of non-referred college students with minimal knowledge of the disorder to "mimic" the symptoms of AD/HD on objective tests presents another concern for the validity of the tests used for diagnosis (Booksh, Pella, Singh & Gouvier, 2010).

There are several scales and tests available for the diagnosis of AD/HD, whether childhood or adult AD/HD. A highly recommended test, the Conners' Continuous Performance Test, has shown in studies to be a better predictor of reading disorders than of AD/HD, but can still be used to identify weaknesses in cognition that may lead to an AD/HD diagnosis (McGee, Clark & Symons, 2000). The Jasper-Goldberg Screening Exam is intended as a primary means of identifying adult patients who may be suffering from AD/HD (Jasper & Goldberg, 2006). Another adult screening test, the Wender Utah Rating Scale, was developed in an effort to overcome the problems association with retrospective reporting of childhood symptoms (Ward, Wender & Reimherr, 1993). These are only a few of the many tests and scales available to assist diagnosticians in determining if a patient may have AD/HD.

Defined Subtypes

There are currently three recognized subtypes of AD/HD based on certain and specific manifestations of the symptoms of this disorder (APA, 2000). The predominantly inattentive (IN) type is diagnosed if six or more symptoms of the inattention subset of criteria persist in combination with less than six of the hyperactivity subset criteria for at least six months (Solanto, Arnsten & Castellanos, 2001). At the opposite end of the spectrum, the predominantly hyperactive-impulsive (HI) type is the exhibition of six or more hyperactivity subset behaviors with a fewer than six of the inattentive criteria met. If both inattentive and hyperactive-impulsive behaviors are highly present (six or more symptoms of each subset), the patient is diagnosed as combined (CB) type.

These subtypes have been questioned by many researchers and clinicians as it appears that often the difference between a specific subtype diagnosis is subjective based on the diagnostician. Studies attempting to identify key distinctions between these subtypes have returned with mixed results. Using ratings from teachers on classroom behavior and performance, Gaub and Carlson (1997) found support for the subtypes, with all AD/HD children being demonstrably impaired compared to non-referred classmates, but with the children falling into each AD/HD subtype showing a consistent pattern of distinct behaviors based on assessments.

A study by Schmitz, et al.., (2002) used neuropsychological tests to determine a distinction between the types. Data from these tests indicated that IN subtype participants performed more poorly on Digit Span and Stroop Test, CB performed poorly on Digit Span and Wisconsin Card-Sorting Test, while HI did not appear to perform more poorly on any tests than the non-referred controls. The authors concluded that these subtypes were effective due to these differences in performance. Another similar test, however, did not produce the same results and concluded that there were more distinctions as a result of gender than were present as a result of subtype diagnosis (Nigg, Blaskey, Huang-Pollock & Rappley, 2002). A study of executive functioning (the ability of the brain to allocate resources and process information) of those diagnosed under different subtypes also indicated there were few distinctions (Geurts, Verté, Oosterlaan, Roeyers & Sergeant, 2004). No conclusive evidence has effectively supported or refuted the subtype designations, and it would appear that the subtypes can be treated using the same methods (treatment is discussed later in this chapter).

Prevalence of AD/HD

The DSM-IV-TR estimates that between 3% and 7% of school-age children meet the criteria for an AD/HD diagnosis (APA, 2000). Determining an accurate percentage of individuals with AD/HD can be difficult due to many factors, including diagnostic subjectivity and gender differences in the manifestation of the disorder. Based on sampling a Baltimore, Maryland school district a 1987 study determined that 6% of the child population in that district was being treated with stimulant medication for the management of AD/HD but did not assess how many children may have given a diagnosis of AD/HD (Safer & Krager, 1988). In 1995 a study two districts in Virginia were sampled and it was estimated that between 8% and 10% of the children were being treated with stimulant medication (LeFever, Dawson & Morrow, 1999). In 2002, Rowland, et al.., reaffirmed that estimate, finding that 10% of the children in grades 1 through 5 had been diagnosed with AD/HD while around 7% were being treated for the disorder using stimulant medication.

Many medical and non-medical sources claim that these numbers are the result of overdiagnosis in the United States (e.g. Bogas, 1997; DeGrandpre, 1999; Vatz & Weinberg, 1993). A scrutiny of prevalence studies and research on diagnostic accuracy suggested that there was no evidence to support these claims (Sciutto & Eisenberg, 2007). A meta-analysis of prevalence studies of AD/HD and its corresponding disorders in other countries (in Britain, for example, it is known as hyperkinetic disorder [HKD]) determined that prevalence of AD/HD in the United States is comparable to the prevalence of the disorder in other countries (Faraone, Sergeant, Gillberg & Biederman, 2003). This indicates that these prevalence rates are likely an accurate representation of the incidence of AD/HD in the population.

Much less is known about the prevalence of AD/HD in adults. Although some studies estimate that around 1% to 2% of patients retain AD/HD into adulthood (Murphy & Barkley, 1996; Heiligenstein, Conyers, Berns, Miller & Smith, 1998), a more recent and comprehensive study estimates that this number is closer to 4.4% (Kessler, et al.., 2006). Many clinicians believe that children "outgrow" their symptoms when in fact they have only learned to better control their behavior, leading to an underdiagnosis or elimination of therapy (Resnick, 2005).

Females with ADHD are another group that are less likely to be diagnosed, with researchers expressing concern over the number of untreated female sufferers that may be in the population (Barkley, 2003). These oversights in diagnosis may mean that prevalence estimates are much lower than in reality.

Causes of AD/HD

Several different factors have been proposed in order to explain AD/HD. One suggestion is that the disorder may stem from prenatal exposure to caffeine as a result of the mother's consumption of coffee while the child was in the womb. A study by Markussen-Linnet, et al.., (2009) found that while initially the consumption of coffee was a significant predictor of ADHD, once other confounding factors were accounted for there was no support for these claims. Another study noted that AD/HD symptoms were improved by eliminating preservatives and artificial food colorings from the diet and the authors suggested that these foods may be the cause of AD/HD although no causal link could be established (Boris & Mandel, 1994). Parental groups and researchers have suggested that AD/HD may be a result of overuse of television due to research indicating a link between viewing time and attentional problems, but there is very little causal evidence to suggest this is the case (Stevens & Mulsow, 2006).

Research into the causes of AD/HD has strongly indicated that the disorder is primarily genetic (Solanto, Arnsten, & Castellanos, 2001). Studies of fraternal and identical twins have indicated that AD/HD is highly heritable (Barkley, et al.., 2002). A study examining adopted children diagnosed with AD/HD explored the family histories of both the adoptive and biological families and determined that while adoptive family histories were not a predictor of AD/HD diagnostics, biological family histories significantly predicted a later diagnosis (Sprich, et al.., 2000). This study, and studies like it, enforce that environment is much less involved in the development of this disorder than genetics. Efforts to map the genomes responsible for the development of this disorder have little success, suggesting that multiple alleles may be passed from parent to child resulting in the development of the disorder (Neale, et al.., 2010).

Treatments and Therapies

Stimulant Drug Therapy

Although there are multiple options for treatment of AD/HD behavior, for various reasons the most often used is stimulant drug therapy (Solanto, Arnsten, & Castellanos). This form of management is most effective for immediate treatment of symptoms. Also, because AD/HD is a legitimate cognitive issue and not necessarily the result of environmental factors, stimulant therapy is the most effective in providing patients with relief from symptoms that can result in educational and career issues. Approximately 23.7% of children diagnosed with AD/HD are treated with medication (Olfson, Crystal, Huang & Gerhard, 2010).

The effectiveness of stimulant drugs as a therapy for AD/HD symptoms was first noticed when hyperactive children were observed exhibiting better self control and calmer behavior after being treated with amphetamines, and has remained a popular means of managing the disorder (Ksir, Hart, & Ray, 2008). Methylphenidate's (Ritalin) effectiveness in treatment of AD/HD symptoms has been established both in a clinical and research setting (Musten, Firestone, Pisterman, Bennett, & Mercer, 1997). Other stimulants like D-amphetamine (Adderall, Dexedrine) and norepinephrine have also been used in the treatment of AD/HD. The effects of stimulant drugs are intended for management of symptoms, not therapy for improvement of the disease overall (Solanto, Arnsten, & Castellanos, 2001).

Although stimulant drug therapy is a popular method of managing AD/HD symptoms, the exact pathway effects in the brain are not completely understood. For the most part research studies have found mixed and sometimes conflicting results (Solanto, Arnsten, & Castellanos, 2001). Two studies, however, had a rare overlapping finding. A study conducted by Ernst et al. (1994), in which EEG was conducted to look for brain activity after the administration of stimulant drug D-amphetamine (clinically known as Adderall or Dexedrine, among others) found an increase in glucose metabolism in the cerebellum. Three years later, Volkow et al. (1997) found the same pattern of activity in the cerebellum after the administration of norepinephrine.

These studies are important because of the uncommon occurrence of similar results from observing brain activity following the administration of stimulant drug medication. Increased metabolism of glucose would provide the brain with increased physical resources available for cognitive processes. As is discussed in the chapter on limited resource models (p. 36), an increase in glucose available to the brain can result in more effective exertion of self-control, something that many AD/HD sufferers find difficult without the aid of medication.

While stimulant drugs are generally effective in managing symptoms, there are some unpleasant side effects associated with stimulant drug treatments, such as loss of appetite and anxiety. A study by Efron, Jarman, and Barker (1997), however, suggested that these side effects may not be a result of stimulant drugs, but instead symptomatic of the disorder. Another, more rare side effect of these stimulants is the development of tics in the patient, making it more difficult to continue the stimulant medication treatment (Varley, Vincent, Varley & Calderon, 2001). Most concerning is the sudden death of youth that has been strongly correlated with use of stimulant drugs treatments for AD/HD symptoms (Gould, et al.., 2009).

Concerns have been expressed that the use of stimulant medication to treat children may be unethical and result in stunted growth, poor social and cognitive development (Breggin, 2008). Studies provide no substantial support for the idea that early stimulant therapy increases the likelihood of abusing substances in adulthood (Wilens, Faraone, Biederman & Gunawardene, 2003). Due to the relative availability of stimulant medication to young populations, the abuse of these prescriptions by non-referred children and young adults is another concern. A meta analysis of diversion and misuse studies conducted by Wilens, et al.., (2008) suggested that around 5% to 9% of school-age children were taking medications not prescribed to them, with that rate increasing to a upper range of 35% of college-age students abusing these medications.

Therapy

Due to the risks associated with stimulant drug treatment, other methods of treating the symptoms of AD/HD have been sought by researchers, clinicians, and physicians. Various types of therapy are one approach that may have promising results. A study of the long-term effects of cognitive-behavioral group rehabilitation was conducted in Finland in order to assess the efficacy of this treatment (Salakari, et al.., 2010). During 11 weekly sessions led by a psychologist, a group of adults diagnosed with AD/HD were guided through self-help lessons on topics such as memory, organization, self-esteem, and discussion on the causes and comorbitities association with AD/HD. An initial self-assessment by the participants was taken and then taken again after three and six months to see what long-term effects the group therapy sessions had on the lives of participants. Ultimately 72% of the reachable participants reported an improvement in their quality of life at the six-month follow-up. 17 (68%) of the participants were taking medication during the time of the sessions. At the six-month follow-up, 3 participants had stopped medication completely, one had started medication treatment, and one who had stopped medication during the therapy sessions had started the treatment again.

AD/HD coaching for diagnosed adults was also examined in another study with similar results (Kubik, 2010). While most adults approved on several measured dimensions, the author acknowledged that this therapy did not improve symptoms as effectively as stimulant drugs. In other studies of therapy's effects on the symptoms of AD/HD, similar results have been found (e.g. Hesslinger, et al.., 2002; Prevatt, Lampropoulos, Bowles & Garret, 2011). One explanation is research supporting the idea that the reward center of those with AD/HD is less responsive, resulting in little to no positive behavioral adjustment as a result of positive reinforcement alone (Solanto, Arnsten & Castellanos, 2001). This deficiency may be evident in the physiological and recall data of the AD/HD participants, and so the following hypothesis is proposed:

H_{2a}: HR for appetitive clips will be lower than for aversive clips in all participants.

H_{2b}: Because those with AD/HD usually respond less to positive reinforcement or rewards, HR for appetitive clips will be lower in diagnosed than non-referred participants.

H_{3a}: The number of SCRs for each participant will be lower for appetitive than aversive clips.

H_{3b}: The number of SCRs for AD/HD participants will be lower for appetitive clips than non-referred participants.

H_{4a}: Recall (as represented by d') for appetitive clips will be lower than for aversive clips.

H_{4b}: AD/HD participants' recall (as represented by d') for appetitive clips will be lower than non-referred participants in the signal detection tests.

These results indicate that this type of therapy, while useful for improving some aspects of the participants' lives, is still not an effective replacement for stimulant drug treatment. Effects are short –term and not comparable to the stimulant drugs that are most often used to manage symptoms of the disorder. The benefits are counterbalanced by the time, effort, and expenses associated with weekly therapy meetings. Even so, therapy is recommended as a supplement for stimulant medication, especially in cases where patients still have difficulty with symptoms while being treated with stimulant medication (Murphy, 2005).

Other Treatments

Over the years a few other possible treatments have been proposed as a substitute or supplement to stimulant medication. One study replaced traditional medications with a different commonly used stimulant – nicotine (Conners, et al.., 1996). A transdermal nicotine patch (the same as those used by smokers to try to stop smoking) was given to untreated adults diagnosed with AD/HD, 7 mg a day for non-smokers and 21 mg a day for smokers. Significant improvements were made in behavior and performance on daily tasks, reflecting the efficacy of traditional stimulant therapies, and during the study few side effects were noticed.

Other, less chemically-centered treatments have also been offered as a possibility for managing symptoms in those with AD/HD. One suggestion by several researchers is to supplement AD/HD patients' diets with micronutrients. Micronutrient refers to a range of vitamins and minerals that humans (and most living organisms) require in very small amounts in order to perform important bodily functions (Ames, 1998). These include minerals like iron and zinc and vitamins like B_{12}, folic acid, B_6, C, E, and niacin. A few studies have examined individual micronutrients' effects on AD/HD symptoms, with two studies specifically on zinc sulfate (Akhondzadeh, Mohammadi & Khademi, 2004) and magnesium (Starobrat-Hermelin & Kozielec, 1997) showing some improvement in AD/HD symptoms. Another study found that supplementing AD/HD patients' diets with flax oil (a source of unsaturated fatty acids) and vitamin C reduced hyperactivity symptoms in children.

While several studies have examined only one or two micronutrients at a time, it is possible that supplementing several of these at once could result in more effective improvement on AD/HD symptoms. An eight-week open label trial with fourteen non-medicated adults suffering from AD/HD was conducted by Rucklidge, Taylor and Whitehead (2011) to see what effects multiple micronutrient supplements would have. Participants were given capsules containing several different micronutrients. An improvement was made to quality of life ratings, hyperactivity symptoms, and depression symptoms, but insignificant change was made to inattention symptoms in these patients.

Comorbidity

Comorbidity is the increased incidence of certain psychiatric, health, and behavioral issues that occur with another main condition (in this case, AD/HD). Several comorbid disorders have been noted in patients with AD/HD, and may serve to confound or delay an accurate diagnosis, especially in females (Quinn, 2005). Comorbidities can mask AD/HD and lead to alternate diagnoses and mistreatments, or they can make it difficult to distinguish the conditions from one another and treat both at the same time.

Comorbid Psychiatric Disorders

One of the most common comorbid disorders is oppositional defiant disorder (ODD), a behavioral disorder that may affect as much as 20% of school age children (Steiner & Remsing, 2007). Children with ODD generally display ignorance and willful disobedience of authority, aggression toward others, and have few or no friends due to their behavior. Prevalence rates of ODD in conjunction with diagnosed AD/HD are between 30% and 50% (Biederman, Newcorn & Sprich, 1991). Similar to ODD, conduct disorder (CD) is marked by a child's aggression, cruelty toward people and animals, lying, truancy, vandalism and stealing (Lahey, Moffitt & Caspi, 2003). Prevalence rates for this disorder in those diagnosed with AD/HD are around 14% (MTA Cooperative Group, 1999). Due to the behavioral symptoms of these disorders, the overlap between AD/HD and ODD and CD is obvious, but the key to determining which is the primary disorder and which is the comorbid condition is heavily reliant on what realm of life is impacted the most by the disorders.

Other comorbid conditions have high prevalence rates associated with a diagnosis of AD/HD as well. Anxiety (outside of common phobias) and depression are especially prevalent in females with AD/HD (Biederman, et al.., 2002). Overall prevalence of anxiety disorders is around 35% (MTA Cooperative Group, 1999). Studies on depression and comorbidity with AD/HD have been less conclusive, finding a range of 5% to over 50% of sufferers who also meet the criteria for major depression (Brunsvold, Oepen, Federman & Akins, 2008). One reason for this range is the difficulty in separating the symptoms of AD/HD from depression, symptoms such as inattention and irritability.

Tourette's syndrome (TS) also shows a high comorbidity with AD/HD, but it is difficult for clinicians to separate the two conditions (Spencer, et al.., 1998). Tics are another concern with AD/HD, and these may be a result of comorbid TS or an independent development (Varley, et al.., 2001). One of the major problems associated with comorbid tics is the aggravation of involuntary muscle movement by the stimulant medications used to treat the main disorder.

Comorbid Drug Abuse

As a result of the symptoms, societal pressures, and comorbid conditions discussed earlier in the chapter, a higher incidence of drug use is common in those with AD/HD. According to one study of 120 referred adults compared to 268 non-referred controls, adults with

AD/HD had a significantly higher lifetime risk for substance use than the controls that was nearly double the likelihood of drug use by the non-referred adults (Biederman, Wilens, Mick, Milberger, Spencer & Faraone, 1995). AD/HD was also found as a predictor of earlier onset of substance use (Wilens, Biederman, Mick, Faraone & Spencer, 1997) and earlier tobacco use (Milberger, Biederman, Faraone, Chen & Jones, 1997). A study examining a group of patients with a substance use disorder (SUD), focused on cocaine use and/or alcohol abuse, found that of the 136 participants studied, 32% met the criteria for adult AD/HD and 35% had been diagnosed with AD/HD as children (Clure, Brady, Saladin, Johnson, Waid & Rittenbury, 1999).

A meta-analysis of the literature eliminated childhood stimulant therapy as a significant predictor of adult drug abuse (Wilens, et al.., 2003). It would seem, then, that the inclination to use drugs is inherent to the disorder or a solution to its symptoms, and not a result of early stimulant drug use. One empirically supported explanation is that the comorbid AD/HD conditions mediate the likelihood of substance abuse. Externalizing disorders, such as ODD or CD, were significant predictors of drug use in adolescents, while AD/HD alone was not (August, Winters, Realmuto, Fahnhorst, Botzet & Lee, 2006). Another study found AD/HD was a predictor of alcohol use, but illicit drug use likelihood increased with comorbid ODD (Molina & Pelham, 2003). Many other studies have echoed these findings, noting that AD/HD alone is not a significant contributor to the likelihood of drug use, but that AD/HD and its comorbidities are (e.g. Barkley, Fischer, Smallish & Fletcher, 2004; Disney, Elkins, McGue & Iacono, 1999). Of 96 AD/HD participants in a study on lifetime achievements and behaviors, 43% considered themselves drug dependent, and 14.9% considered themselves an alcoholic (Murphy, Barkley & Bush, 2002).

Impact of AD/HD

The impact of AD/HD on those who suffer from the disorder are far reaching and affect many aspects of their lives. These individuals find themselves struggling in academics, in their careers, and in their intimate relationships. It is not that those with AD/HD are completely incapable of success in these realms, but rather that they must try much harder than their non-referred cohort to achieve the same goals.

Education and Career

The academic setting is usually the first place where symptoms of AD/HD are noticed. The inability to sit still and pay attention to boring or monotonous tasks for extended periods of time make it difficult for children with AD/HD to grasp basic reading, writing, math, and social skills (DuPaul, McGoey, Eckert & VanBrakle, 2001). Children with AD/HD are generally required to repeat grades more often and use special education programs and tutoring more often than their non-referred cohort (Faraone, et al.., 1993). Although children often outgrow the majority of the symptoms, they continue to be stunted in their academic life as they grow in adolescence and adulthood (Weiss & Hechtman, 1993). As the pressures of school work and social lives begin to increase in high school, the stress can aggravate symptoms and be overwhelming, causing a further decline in academic performance (Loe & Feldman, 2007). A large portion of students (≈85%) with AD/HD are likely to face suspension or even expulsion from high school (Murphy, Barkley & Bush).

Low scores on standardized tests will often lead to difficulty in attending post-secondary school. In college, many students report a high amount of parental support (Wilmshurst, Peele & Wilmshurst, 2011). Even so, they are more likely to have educational issues, lower grade point averages (GPAs) and are less likely to actually attain a degree, with only 13.6% of 96 participants with AD/HD reporting that they completed college (Murphy, Barkley & Bush, 2002).

In their careers, the inability to organize, manage time, and complete projects makes it difficult for AD/HD individuals to obtain and hold a job (Nadeau, 2005). Attempts to employ career counselors in order to help them find jobs suitable to their needs are often frustrating and fruitless due to the lack of awareness and training in most of these counselors. Career histories with multiple terminations and poor performance reviews may also be an obstacle in obtaining a more appropriate job.

A study of working college students indicates that regardless of the severity of symptoms, AD/HD employees received poorer work ratings and were more likely to be fired from jobs than their non-referred peers (Shifrin, Proctor & Prevatt, 2010). Emotional impulsiveness in adulthood leads to low employment rates and poor employee evaluations (Barkley & Fischer, 2010). 98% of 105 AD/HD adults reported experiencing impairment in their workplace as a direct result of their disorder (Safren, Sprich, Cooper-Vince, Knouse & Lerner, 2010).

Students with AD/HD face many difficulties in academic achievement. The challenge of behaving appropriately in the classroom leads to difficulty in learning important basic lessons and may result in low grades and repeating years of school. Early adversity may later lead to low grades, low standardized test scores, and low chances of obtaining a college degree. In their pursuit to obtain a satisfying and appropriate career, they are often frustrated by their symptoms and their inability to perform at the same level as non-referred peers.

Relationships and Personal Life

Beyond their public interactions, the private lives of AD/HD individuals are also greatly affected by their disorder. Relationships, finances, criminal records, and even driving behavior can all be impacted by AD/HD behaviors to the detriment of the individual's happiness and well-being.

Because of the lack of awareness and understanding of the disorder by the general population, personal relationships in which one partner has AD/HD are often difficult. College students with AD/HD who are in romantic relationships are less satisfied with their relationship and are unlikely to use positive coping strategies when facing conflict (Overby, Snell & Callis, 2011). These problems carry over into marriage, as evidenced by a study conducted by Robin and Payson (2002) that examined 80 couples in which one partner had diagnosed AD/HD and one was non-referred. Of the non-referred partner's ratings on items that made them feel unloved and unimportant, several common themes arose in nearly every response. The most frequent complaints included "doesn't remember being told things", "says things without thinking", "zones out in conversations" and other behaviors that are strongly associated with the disorder. The lack of communication resulting from the disorder symptoms that can further strain the relationship (Weinstein & Block, 1998).

Impulsive behaviors associated with AD/HD can result in legal troubles as well. A longitudinal study of 207 boys with AD/HD but *not* comorbid CD was conducted to determine likelihood of arrest in comparison to a similar but non-referred control group (Mannuzza, Klein & Moulton, 2008). An initial blind assessment for symptoms was conducted by clinicians while participants were between the ages of 18 and 25. At age 38, official arrest records of 93 AD/HD and 93 controls in the state of New York were examined. Significantly more of the AD/HD individuals were arrested (47% vs. 24%), convicted (42% vs. 14%) and at some point incarcerated (15% vs. 1%).

Other issues impacting the quality of life of those with AD/HD are prevalent as well. Even daily tasks like driving can prove to be more difficult for those diagnosed with AD/HD. Focusing attention and reacting quickly to the environment is important when operating a motor vehicle, and these abilities are decreased by the disorder (Jerome, Segal & Habinski, 2006). Children growing up with AD/HD are more likely to idealize, consider, and commit suicide than their non-referred peers, even when no comorbid MDD is present (Barkley & Fischer, 2005).

Summary

The challenges faced by individuals with AD/HD extend beyond the classroom, but many times difficulties in the classroom add more stress to their lives. The symptoms of AD/HD affect education, career, dating, marriage and may even lead to drug and alcohol abuse later in life. Currently the most effective option for managing the harmful symptoms of AD/HD is the use of stimulant drugs, which can have negative side effects or could even kill users. Therapy, diet change, and even nicotine have all been suggested as replacements to stimulant drugs, but none have been as effective in allowing those with AD/HD to study or perform their jobs. New solutions and alternatives should be found to provide AD/HD individuals attempting to complete their education that can give them a reprieve from the effects of stimulant medication, even if only for an extra day or two out of every week.

CHAPTER 3

MEDIA AND ATTENTION

There are multiple ways in which relationships between attention and the media are explored. One of the most common means of examining this relationship is by determining what features attract attention. The reasons for this line of research are obvious. Research that can be applied to media to attain and maintain viewers' attention is valuable to television programmers and advertisers alike. Comprehensibility of storyline and dialogue (Anderson, Lorch, Field, Erickson & Sanders, 1981), programming attributes (Alwitt, Anderson, Lorch & Levin, 1980), and time spent with television (Anderson, Lorch, Field, Collins & Nathan, 1986) have all been studied to determine their relationship with visual attention.

It is not attention to the television that most researchers are concerned with when it comes to effects on a child's academic success, but rather the attentional abilities (or lack thereof) of viewers that may be the result of too much television viewing. While attention itself is not necessarily a media effect, attentional abilities are clearly under scrutiny as parents and teachers worry about the academic success of their children and students. The study of this effect is important for two reasons. First, any potential damage that television (or other media such as the Internet) may have on the future success of children should be examined and assessed. If risks are involved in watching television, even educational/informational (E/I) programming as regulated by the FCC, parents should be informed in order to make the best decisions regarding their children's education. Second, if television is somehow causing these effects, research into the cognitive processes that result in this degradation of attentional abilities needs to be examined in order to try to "reverse engineer" the effects for application on clinically diagnosed attentional disabilities like AD/HD. The relationship between television and educational outcomes in children is complicated, especially when AD/HD individuals are included in generalizations about this relationship. Although there is a great deal of research indicating the negative impact television viewing has on younger viewers, these negative effects are not as apparent in AD/HD viewers. What could be bad for one group may in fact be highly beneficial for another.

Television

Several studies have explored the question of whether television viewing causes attentional issues or lack of academic success in children. Unfortunately, most of the studies have indicated a link between the two. Levine and Waite (2000) used a television viewing journaling method and parent and teacher evaluations to seek out a correlation. They found that higher consumption of television did correlate to lower ratings on attentional ability evaluations from teachers. The same link was not found for parents' evaluations, however. Obel, et al.. (2004) attempted to recreate this study in a Danish group of children and failed to find the same correlations. This failure to find similar data may be the result of cultural differences between the American and Danish cohorts. These differences could be explained by children's programming offered in the two locations, or societal expectations that vary between the two groups.

Other studies have supported Levine and Waite's (2000) early indications that there was a negative correlation between hours spent watching television and attentional abilities. Özmert, Toyran, and Yurdakök (2002) used a questionnaire filled out by the parents of grade school children to assess how much time each child spent watching television daily and separately assessed many behavioral issues using the Child Behavior Checklist (CBCL). A negative correlation with social and school achievement and television viewing was found, as well as a positive correlation between television viewing and many behavioral problem subscales, including aggression, thought problem, and most importantly for this discussion, attention problems. The researchers also indicated that any time spent viewing television that exceeded two hours daily could potentially predict educational and disciplinary problems.

A more recent longitudinal study of the effects of television viewing on attentional abilities was conducted by Landhuis, Poulton, Welch, and Hancox (2007). By collecting estimates of hours of television viewed at ages 5, 7, 9 and 11 years old and comparing this data with self-, parent-, and teacher-reported attention problems at ages 13 and 15 years old, this study supported Levine and Waite's (2000) conclusions that heavy television viewing later predicted issues with attention. Another study indicated that over one hour of viewing a day was already associated in youths with attentional issues, and that over three hours a day of television viewing was the strongest indicator of increased attentional problems and decreased likelihood of pursuing higher education (Johnson, Cohen, Kasen & Brook, 2007).

Links between AD/HD and television viewing only support the argument that television results in attentional disabilities in the minds of most parent and teacher groups. Acevedo-Polakovich, Lorch & Milich (2007) studied two groups of children, one diagnosed with AD/HD and the other non-referred, and found through an observation of media consumption habits that AD/HD children prefer television much more than their non-referred peers. AD/HD children were much less likely to participate in or enjoy reading than their cohorts. They were also more likely to pay closer attention to television programming than non-referred counterparts. Another study by Landau, Lorch & Milich (1992) on AD/HD versus non-referred children had an interesting finding. When offered toys as a distraction to a television program, AD/HD children only watched the program without distraction about half as long as non-referred children. Later, during recall tests, there was no significant difference between the two groups on information remembered. This seems to indicate that although AD/HD individuals can get distracted by other stimuli in the environment, they still encode, store, and retrieve information. As that was the operational definition of attention in some studies, it would appear that AD/HD individuals are much better at "paying attention" to multiple stimuli at a time than their non-referred counterparts.

Television may not only impact attentional abilities of young viewers, but also the general academic success of these viewers in the future. Christakis, Zimmerman, DiGiuseppe, and McCarty (2004) found another link between television viewing and educational success. A longitudinal study that collected data on children from infancy to age eight found that higher amounts of television viewing during ages one through three years old predicted a lack of academic success (in terms of grades and teacher evaluations) at age seven. Borzokowski & Robinson (2005) found a correlation between lack of academic success and a television set in the child's bedroom. Miller, et al. (2007) indicated that amount of television viewing correlated to hyperactivity in toddlers. While none of these directly point to attentional problems, there is clearly a correlation between television viewing and difficulty in obtaining academic success. This relationship could be a result of other factors, such as parental involvement or a correlation between lack of academic ambition and desire to watch television. It is also important to consider that time spent watching television is not time completely dedicated to the completion of other tasks, such as homework or studying.

It seems that the correlation between AD/HD and television consumption can actually be explained by the nature of the disorder itself. AD/HD is often characterized by fast paced, disorganized thoughts and high amounts of sometimes uncontrollable energy (Barkley, 2003). As a result of these symptoms, AD/HD individuals are often bored and seek out arousing entertainment. When choosing between a book, which would require the focus of sometimes difficult to maintain attention, or a fast paced television program, the AD/HD individual would reasonably seek out the more arousing of the two options, the television program. This almost thrill-seeking behavior can be seen at an early age in AD/HD individuals. As adolescents and teenagers, AD/HD individuals are much more likely to forego academic or career-oriented tasks for entertainment-oriented tasks more often than their non-referred peers (Whalen, et al., 2002). They are also more likely to take part in risky behavior such as drug and alcohol abuse. As adults, AD/HD is often comorbid with anxiety disorders and there is a high incidence of drug abuse (especially stimulants) associated with adult AD/HD. Television may serve as an early form of thrill for many young viewers suffering with AD/HD, causing them to watch it more often. Communication theorists have suggested that media choices, including the type of media used, could result from underlying emotional-management objectives (Zillman & Bryant, 1985), so it does not seem unreasonable to assume that the same may be happening here. It seems more likely that the direction of effects is opposite of what many parents fear and less likely that television viewing results in AD/HD.

One possible cause for the more recent surge in efforts to link television and AD/HD (or attentional problems in general) is the explosion of clinically diagnosed cases of AD/HD over the past 15 years. The issue with diagnosis, however, is that many general practice healthcare providers are not properly qualified to diagnose this disorder (Biederman, et al., 2002). Actual clinical diagnosis by a trained professional can take an extended period of time and includes not only evaluations and testing using stimulant drugs, but also parent and teacher evaluations that are intended to demonstrate the hardships imposed by the disorder. AD/HD researchers and experts believe that the actual incidence of AD/HD in the population at large is much lower than the number of patients who claim to be AD/HD and are diagnosed by an untrained general practitioner (Biederman, et al., 2002). At the same time, more recent study into AD/HD in women has determined that many have gone undiagnosed and untreated as a result of differences in manifestation (Biederman, 2005). Whereas male sufferers of AD/HD are often diagnosed at an early age because of the very obvious and detrimental emphasis of the hyperactive symptoms of the disorder, female sufferers tend to go unnoticed because AD/HD in females generally impacts the cognitive symptoms, such as disorganization of thoughts and inability to focus on details in a project. This lack of female diagnosis could actually be contributing to the findings of attentional disability studies on what researchers have assumed were non-referred (and thus non-AD/HD) participants.

There should be very little concern that television viewing results in learning disorders such as AD/HD. To assume that this is the case is to basically believe in medical superstition. Meta-analysis of television viewing and AD/HD studies has indicated that television is an insignificant predictor of AD/HD (Stevens & Mulsow, 2006). A longitudinal study of AD/HD and non-referred children also refutes a causal relationship between television and AD/HD (Acevedo-Polakovich, Lorch, Milich & Ashby, 2006). Learning disorders are almost always the result of genetics or some type of brain damage. AD/HD, for example, can generally be found in several generations of the same family (Solanto, Arnsten, & Castellanos, 2001). Although the exact cause of AD/HD and the pathways or cognitive processes that are different in AD/HD individuals are still under question in the scientific community, at no point do most AD/HD researchers believe that a learning disorder can come from something as mundane as television. More likely, television and the more recently developed interactive media (such as smart phones, websites, smart boards, and others) could actually assist AD/HD individuals as they attempt to manage their disorder.

Although there is a great deal of research available that establishes a link between television viewing and a lack of academic success, it seems that it is more likely that other confounding variables, such as parental involvement or students' own ambitions, are at play. For parents concerned about the welfare of their children, reasonable management of time spent watching television and moderating effects of parental involvement would likely prevent most of the attentional effects of the media. As far as the link between AD/HD and television is concerned, research in other areas of AD/HD study as cited above would make an excellent case for the use of television by AD/HD individuals as a form of therapy for unruly symptoms. If this is the case, then applications for media as an educational and management tool for AD/HD individuals is a promising horizon for research.

Video Games and the Internet

Television is no longer the only media with which children spend large amounts of time. Now video games, the Internet, and smart phones are all integrated into the daily activities of the American child and adolescent (Lenhart, Purcell, Smith & Zickuhr, 2010). Unlike television, which researchers have examined for decades to determine its impact on academic and career success on the children watching, these media have had a shorter time in the research spotlight.

Most dialogue and empirical research on video gaming focuses heavily on the violent messages and images associated with most popular games (e.g. Anderson & Dill, 2000). As video games have grown in popularity from a childhood plaything to an adult recreational activity, the interest in the effects and possibilities of these games has grown as well (Gee, 2003). One often-noted benefit of video gaming is the improvement of visual spatial skills, with both child and adult players exhibiting faster reaction times than non-player peers in studies (Yuji, 1996; Kuhlman & Beitel, 1991; Orosy-Fildes & Allan, 1989). Studies have also indicated that these games aid players in practicing problem solving and critical thinking (Schmidt & Vandewater, 2008).

While video games do have positive effects, academic success has been negatively correlated with time spent by children playing video games on computers and consoles (e.g. Roe & Muijs, 1998; van Schie & Wegman, 1997; Anderson & Dill, 2000; Walsh, 2000). Gaming is also correlated with school violence and aggression toward teachers (Gentile, Lynch, Linder & Walsh, 2004). Overall, the benefits of improved hand-eye coordination and potential problem solving skills do not compensate for the time that video gaming consumes in place of studying or reading.

Much like with television, the relationship between AD/HD and video games has been a question of parents and researchers. A study of 144 undiagnosed high school students found a correlation between video game play and AD/HD symptoms, particularly inattention (Chan & Rabinowitz, 2006). Symptoms were obtained by self-ratings and parent and teacher ratings of behavior at home and school. Another study found that, when treated with methyphenidate, many AD/HD adolescents significantly reduced the amount of time spent playing video games (Han, et al., 2009). This suggests that the stimulating nature of video games may serve as a means of self-medication when stimulant medication is not available.

Video games are not a good solution to AD/HD issues, however. Overall, a meta-analysis of the literature on video games indicates that it is a favorite pastime of AD/HD adolescents much to their own detriment, often resulting in bad moods, lack of sleep, skipping meals, and academic trouble (Ballas, 2009).

Summary

Although the news media often blame television, video games, and the Internet for the development of AD/HD in schoolchildren, empirical research suggests that this is not the case. In non-referred children, it does appear that television results in poorer academic performance, behavioral problems, and a decreased likelihood of later educational success. In those with AD/HD television does serve to aggravate the inattention component of the disorder, but otherwise does not result in the development of the disorder in non-referred children.

While watching television or playing video games, AD/HD children seem to be soothed by the arousing content of the media. Because there seem to be significant differences in the way that AD/HD individuals consume television and other media, and in the way that they watch television as compared to their non-referred cohort, the following research questions are proposed:

RQ_1: What differences in physiological data will be observed between diagnosed and non-referred groups?

RQ_2: What difference in self-reported enjoyment, excitement, and control will be observed between diagnosed and non-referred groups?

CHAPTER 4

COGNITION AND SELF-REGULATION: LIMITED RESOURCE THEORIES

For centuries the study of behavior has been a topic explored by ancient philosophers, medieval scientists, and modern psychologists. It was not until the 1950s, however, that the field of psychology began to truly acknowledge the basic underpinnings of all human behavior: the human brain. Where other branches of psychology explored the effects of personality, upbringing, societal pressures, and many other factors in the behavior of people, cognitive psychology was determined to look at the basic processes that occurred in the more primitive portion of the brain (Baars, 1986).

Criticisms have been made about the underlying assumptions of cognitive models of information processing, namely that these models remove the humanity from the human mind. By looking only at the brain and its processes, the factors that make each person an individual are forgotten in favor of a concept of humans as machines with a certain set of procedures and reactions. Alone, research on cognition cannot explain all of the variables that contribute to behavior. For the purposes of a study examining information processing in a population with a disorder affecting their cognition, however, it is ideal.

Overview of Cognition and Learning

How information is obtained, processed, and stored has long been an interest of cognitive psychological studies. These processes are also important in the study of AD/HD individuals because dysfunctions in these processes are the cause of the symptoms and educational challenges that are faced by those diagnosed with AD/HD. In order to understand how the AD/HD mind works, it is important to understand some basic concepts in the learning process for the average human brain.

The limited capacity model first proposed by Kahneman (1973) is a popular theory on how the brain accomplishes obtaining and remembering new knowledge. It suggests that the brain has a limited amount of resources that can be used for each of the steps in the process of attention, information processing, and storage of memories. These resources are also used for other purposes within the brain, and so performance of any of these processes consumes the limited pool until the process is completed. The easier or more automatic a task becomes, the fewer resources will be required for completing that task (Wickens, 1991). Studies have indicated these resources are consumed by focusing attention (Hoffman, Nelson & Houck, 1983), processing information from the environment (Wickens, Kramer, Vanasse & Donchin, 1983) and committing that information to memory (Lemaire, 1996).

In order to effectively process and store information, several processes have to occur in the human brain. Encoding is the process by which information is observed from the environment in order for it to be analyzed and stored (Anderson, 1983). Whether or not environmental details are encoded can be dependent on a great deal of factors, usually as a result of the focus of attention. Multiple theories have been proposed on how attention is focused, although voluntary attention is the central interest in this study as intentionally controlled attention is a deficiency in the AD/HD individual. It is assumed by most researchers that voluntary attention is the result of the processing of preattentive cues in the environment and determining that, for one reason or another, an element of the environment should have more resources dedicated to its analysis (Van Der Heijden, 1998). One theory on this initial processing is the feature integration theory, which assumes that structural features such as color and shape would result in this shift of attention (Treisman, 1988). Auditory stimuli could also have a similar attraction of attention function due to familiarity of sounds, such as an individual's name.

Once an individual's voluntary attention has been attained, encoding will occur and, depending on the nature of the information, decoding of letters, numbers, or symbols will occur based on rules that have been learned earlier by the brain (Thagard, 2005). Assuming there are enough resources available, storage of information will occur by generating as many connections to previously learned information as possible, creating a network of associated knowledge (Milner, Squire & Kandel, 1998). The more connections to other stored information, the better and faster recall will be at a later time. Cognitive resources are necessary for this strong series of links between acquired and previously stored information and if they are not sufficiently available at the time of storage it will be difficult to recall information without strong cues (Kahneman, 1973).

As evidenced by the review, and as discussed by Kahneman (1973), resources are crucial to the effective encoding and storage of information for later retrieval. These resources are finite and can be consumed by many cognitive processes. Resources can be overtaxed by environmental factors, such as distractions or threats, and a lack of resources available for encoding and storage can result in cognitive overload (Sweller, 1988). At the point of cognitive overload encoding and storage will greatly suffer and the quality of recalled information will be very poor.

Resource management is an important part of processing information, both to ensure that resources are allocated to necessary environmental information and to avoid cognitive overload if at all possible. In order to manage those resources, the brain relies on the executive system or executive function (EF), which is seated in the prefrontal lobe (D'Esposito, Detre, Alsop, Shin, Atlas, & Grossman, 1995). This system is most heavily involved in non-automatic process, particularly in five types of situation as outlined by Norman and Shallice (1980): those involving plans or decision making; those involving error correction or troubleshooting; those where a novel sequence of actions are encountered; dangerous or technically challenging situations; situations requiring the overcoming of strong habitual responses/resisting temptation.

Executive Function and AD/HD

As indicated by Norman and Shallice (1980), executive function is key in the process of resisting habitual responses and resisting temptation, which are also failures in the behavior of AD/HD individuals. Because of this correlation, one cognitive theory of AD/HD is that an impairment in executive functioning results in the lack of impulse control and the difficulty in focusing attention. Many researchers have proposed that these symptoms arise from a specific domain function of the EF.

A study by Boucugnani and Jones (1989) compared AD/HD and non-referred children in the ability to complete tasks associated with frontal lobe function (i.e. Wisconsin Card Sorting Test, Stroop Color-Word Test). Significant differences were found between groups on variables of perseverance, self-motivated attention, and inhibitory behavior. These findings were some of the first to strongly suggest a connection between AD/HD and EF. Based on this and similar studies, Barkley (1997) proposed a theory of prefrontal dysfunction as a potential explanation for the cognitive symptoms of AD/HD.

Further experimental support was found by Barnett, et al., (2001) when they compared three groups – medicated AD/HD children, non-medicated AD/HD, and non-referred control group – on spatial working memory tasks intended to assess EF efficacy. Again the study found a significant difference between the non-medicated AD/HD group and the other two groups. Another study conducted the same year indicated that this phenomena was not necessarily a result of age when a diagnosed and control group of teenagers were compared on a variety of EF psychological assessments (Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001). An overview of neurological AD/HD research indicated that executive function is popularly to blame for many symptoms (Woods, Lovejoy, & Ball, 2002).

Although a great deal of research does indicate that there is likely a relationship between executive dysfunction and AD/HD, especially in adult patients, a meta-analysis conducted by Willcutt, Doyle, Nigg, Faraone, and Pennington (2005) suggests that EF may not explain *all* cases of AD/HD in adults, raising the question of whether different subtypes of AD/HD may result from different cognitive dysfunctions.

Limited Capacity Model for Motivated Mediated Message Processing

In the field of communication, there are few theories dealing with the cognitive processing of mediated messages. One theory is Lang's (2000) limited capacity model for motivated mediated message processing (LC4MP). Borrowing liberally from cognitive psychology's findings and models, this theory focuses on how the human brain processes messages presented on the television screen.

LC4MP rests on the assumption that the human brain has a limited amount of resources available for the processing of environmental information, and in the case of LC4MP, the processing of mediated messages (Lang, Bradley, Park, Shin & Chung, 2006). This is drawn from Kahnemann's (1973) limited capacity model, in which the limited abilities of the brain to observe, analyze, and react to information was first outlined. This model is generally agreed upon in cognitive psychology research, as other competing models have not effectively explained the processing abilities of the brain and its limitations. Kahnemann (1973) proposed that the brain's resources were limited, and that stimuli could sap those resources until the point of cognitive overload. Like Kahnemann, Lang (2000) proposed that mediated messages were also cause for the consumption of cognitive resources that could result in poor processing. LC4MP also assumes that, much like the real world environment, processing information from the television environment consumes resources. Multiple elements of video messaging have been studied in terms of their ability to consume resources, including color, pacing (Lang, Zhou, Schwartz, Bolls & Potter, 2000), and information introduced at edits (Lang, Park, Sanders-Jackson, Wilson & Wang, 2007).

According to LC4MP, resources are allocated to the processing of mediated messages based on several factors like those listed above. Allocation of resources results in the dedication of processing power to the stimuli presented, and these resources will be used in the encoding and storage processes (Lang, 2000). Several strategies can be used in creating video messages that will result in an increase in the amount of resources allocated. Valence, for example, can have a significant effect on the recall of information from a clip, with aversively valenced clips resulting in more resources allocated and better recall than appetitively valenced clips (Lang &

Dhillon, 1995; Lang, et al.., 2007). Appetitive clips, however, result in more allocation than neutral clips.

Pacing can also have a significant effect on recall of participants after viewing messages (Lang, et al., 2000). Pacing refers to the number of edits, or a change from one image to another, over a set period of time. The pacing of a clip has a direct correlation to both physiological and self-reported arousal, as well as improved recall of information from faster paced clips. Combining both fast paced editing and arousing content, however, can have a negative effect on subsequent recall when these features tax the cognitive resources available for environmental processing, leading to cognitive overload (Lang, Bolls, Potter & Kawahara, 1999).

H_{2a}: HR for appetitive clips will be lower than for aversive clips in all participants.

H_{2b}: Because those with AD/HD usually respond less to positive reinforcement or rewards, HR for appetitive clips will be lower in diagnosed than non-referred participants.

H_{3a}: The number of SCRs for each participant will be lower for appetitive than aversive clips.

H_{3b}: The number of SCRs for AD/HD participants will be lower for appetitive clips than non-referred participants.

H_{4a}: Recall for appetitive clips will be lower than for aversive clips.

H_{4b}: AD/HD participants' recall for appetitive clips will be lower than non-referred participants in the signal detection tests.

H_{5a}: As pacing increases, HR will increase in both groups until the point of cognitive overload.

H_{5b}: Non-referred participants will reach cognitive overload first, resulting in lower heart rates on fast paced clips than the AD/HD participants.

H_6: As pacing increases, SCRs will be more frequent in both groups until the point of cognitive overload.

H_7: Non-referred participants will reach cognitive overload more quickly, resulting in lower scores than the AD/HD participants on fast paced aversive clips.

Introduction of new information at these edits, however, can result in outstripping available resources and also ultimately causing cognitive overload in viewers, resulting in poor recall (Lang, et al., 2007). In order to determine information introduced (I^2), or the amount of jarring changes at each individual edit, a coding sheet with seven categories was created. Object change indicates the change in focus of the shot from one object or person to another. Novelty regards whether the focal point at the edit is old or new. Relatedness is used to determine if the change at the edit was related to the previous shot. Perspective is used to code whether the camera angle on a focal point changes in some way at the edit, while the item distance is also an indication of changes in camera location after the edit. Emotion, or changes in valence or arousal level at an edit, is also coded. Finally, form change, or changes from live action to animation, black and white to color, etc., is also likely to consume resources.

These categories were chosen due to their ability to consume resources as the viewer experiences a sudden orienting response (OR). A binary "yes" (1) or "no" (0) for whether that particular visual information was introduced at the edit reveals a score of zero through seven. In this way, I^2 is calculated and operationalized in order to facilitate development of stimulus materials. Lang, et al., (2007) assumes that high I^2 will result in higher resource allocation until the point of cognitive overload.

What LC4MP does not often account for is that there are differences between participants in how many cognitive resources are available. Working memory capacity (WMC) has been studied by many cognitive psychologists. This capacity is the ability of an individual to hold and analyze thoughts, keep information, and picture images visually in their mind in order to manipulate them (e.g. Feldman-Barrett, Tugade & Engle, 2004). WMC has been associated with IQ, and cognitive psychologists acknowledge that WMC is an important factor in the ability of individuals to process information and solve problems. Higher WMC results in more cognitive efficiency, more cognitive resources available for processing information, and more effective task completion. LC4MP often assumes that all cognitive resources are roughly the same between individuals. Pre-testing for WMC using simple problem solving tasks could refine research on and applications for the impact of WMC on mediated message processing. Commercials targeting more intelligent, higher achieving individuals, for example, may need to use different structural features than those targeting those who wish to expend fewer cognitive resources when making decisions on a purchase. This WMC line of study would also serve as a means of exploring concepts like the elaboration likelihood model (ELM), which may tie WMC to processing of advertisements.

LC4MP often relies on physiological indications of attention to serve as a means of quantifying attention, such as lowered HR. Attention is more complicated than a simple binary on/off switch, however, as Triesman (1988) indicated in her attenuation model of selective attention. Attention is much more complicated according to Triesman's model, in which certain cue words can attract more attention, and certain details can be missed altogether as a result of lack of attention. That is not to say that the brain does not encode this information, but that it is almost impossible to retrieve. An example of this model is what is sometimes referred to the “cocktail party effect” when a person can suddenly pick a single conversation out of a crowded room because their name was included in the comments. A lack of interest or motivation, on the other hand, can result in the lack of observation of important details. Someone may have heard in passing the time and location of an important meeting, but the lack of cue words associated with that importance results in a lack of attentiveness.

Because attention is not a binary concept, cue words and visuals may be serving as a confounding variable in the results of LC4MP studies. With only 50 participants in a study, it may be possible that these cue words impact enough participants to create an effect that does not really exist. But how can cue words make a difference in an overall study on cognitive resources and memory? LC4MP often uses recall tests as a means of testing for encoding, storage, and retrieval. Based on cognitive psychology research, these concepts are also slightly more complicated than proposed by LC4MP. Encoding, for example, can be cognitively simple or extremely taxing on cognitive resources depending on the circumstances of encoding. While Lang, et al., (2006) is reasonable in assuming that structural features and the amount of visual information available in 30 second clips have an impact on cognitive resources and thus encoding, there are other factors at play as well.

When the human brain encodes information, it converts it into a “code” in order to make it simpler to retrieve at a later time. Often these codes are links to other memories or information about the topic that is being encoded. Visual information in the form of a still picture of a cardinal, for example, will link to other visual memories of birds, to the word “cardinal” in your head, and to any outstanding memories of cardinals you may have. All of this will facilitate retrieval at a later time. So if cue words like those proposed in the attenuation model are present in a clip, the amount of cognitive resources to “code” that memory during the encoding and storage process will be much lower for the participants responding to cue words. Remembering something your favorite actress said about a product will require much fewer cognitive resources than a commercial with the same structural features and visual information that featured an actor you'd never seen before.

Recall tests may also be a less effective means of testing the cognitive resources available at the time of encoding and storage because of the fake memories created in the brain as proposed by the false memory paradigm (Roedinger & McDermott, 1995). When given a list of words associated with one key word, participants nearly always recalled that the keyword was part of list, although that was not the case. Participants given the list: "snore", "nap", "snooze", "pillow", "bed" and many other words would unequivocally add "sleep" to the list of words when they were recited. This is likely because the links in the brain between all of these words were activated, causing the participant to "remember" the word being read to them. The same could occur for participants doing recall tests on commercials. Accuracy of guesses on whether or not an image was present may be poor for dopplegangers that resemble too closely the true image that was presented in the clips because it activates the same pathways that the true image did, creating a false memory of seeing that image. A better means of offering a recognition test would be to offer one correct image and two similar incorrect dopplegangers. This allows the brain to process which images it actually saw.

One final concern with the association of post-tests as a means of testing encoding and storage is that the cues may not be appropriate for retrieval. It is thought that the human brain takes in much more information than it will ever retrieve, and that to make sure that information can be retrieved, certain retrieval cues must be available (Tulving & Thompson, 1973). The "tip of the tongue" phenomena in which a word or name cannot be thought of even though the speaker can describe or define it is a result of the wrong retrieval cues. Once the correct retrieval cues are used to access that information, the phenomena disappears and the word is immediately obvious. Cued recall tests, then, may only be a measure of retrieval, as the cues given may not be effective in retrieving otherwise perfectly effective encoded and stored information. Cues in these recalls, therefore, may have to be selected for the information that the researchers desired the participants to recall. For example, in advertising it would be best if viewers could recall brand names and products associated with a commercial. Cues would then be asking for those specific items of information after describing the commercial in detail.

Although there are concerns with the efficacy of signal detection tests, they have been used as a standard in previous studies and can indicate an improvement in resource availability and consumption of resources. Because cognitive resources are a key concept in this study on attention disorders and video pacing, the use of signal detection tests to reveal what resources were available during the video clips will be an effective means of measuring any increase or decrease in resources available.

What makes LC4MP an important model in the study of communication effects is that it explores the cognitive side of message processing, which is often overlooked in communications because of the relatively recent adoption of this type of study. The use of cognitive psychology and psychophysiology to examine media effects is important, because cognitive processes are practically universal across the human population. These cognitive insights help form a foundation of knowledge about how the brain processes messages that can be used to support social psychological examinations of how personality, upbringing, and other factors impact how individuals form perceptions based on mediated messages. As a result, LC4MP, and hopefully other cognitive models that will be created to compete with it, is able to examine human behavior in a way that current studies of mass communication effects cannot.

Self-Regulation

Most cognitive models discuss how resources are drained, but they do not have a solution for replenishing those resources. Self-regulation literature, however, approaches the focused control of behavior from several different angles, one of which even suggests a means of supplementing an expendable resource known as willpower.

Self-regulation is a concept that can be used to aid in explaining a variety of different difficulties that are faced by society. Inherent in the term, self-regulation research examines many aspects of how the self exerts control over habits and reflexive behaviors. Because of the ambiguous nature of the term, self-regulation theories encompass a myriad of behaviors and outcomes that all center around how the self keeps itself in check.

A theoretical context for the lack of self-control exhibited by those diagnosed with AD/HD may be found in self-regulation research. Self-regulation, or the idea that the self manages and controls itself using a variety of methods and resources, has served as a focus of study both in psychological and educational contexts (i.e. Baumeister, 1998; Zimmerman, 1990). Because management of behaviors and cognitive resources required to maintain control over both physical and mental activities in a social or learning environment is a key failure in the AD/HD student, studies of self-regulation in both contexts apply to these participants.

Self-Regulation: A Brief Overview

Self-regulation is the self-monitoring and self-management of behaviors that are automatic in some way but may lead to unpleasant results if allowed to occur without any form of control. Ultimately, self-regulation requires the ability to conceive of and act for the future

(Bandura, 1991). Without that concept there is no need to self-regulate because there is no existence of consequences. Depending on the objectives and approaches of the study of this phenomena, a multitude of behaviors and topics can be examined under the cloak of self-regulation.

Because self-regulation can apply to so many things, narrowing the scope of the self-regulation being discussed in this chapter would be helpful in identifying the aspects of self-regulation important to this study. According to Baumeister (2003), there are three theories of self-regulation that are most often scrutinized. While all three of these theories are interested in the mechanisms of self-regulation and failure to self-regulate, they have vastly different proposals of what those mechanisms may be.

The first of the three theories assumes that willpower is necessary for regulation, and that this willpower is a limited resource that, once depleted, results in a lack of regulation. The second attributes self-regulation to cognitive processes, such that self-regulation is a series of cognitive calculations and assumed outcomes that lead to a decision to obey or resist an impulse. In this theory, self-regulation could be improved with an expansion of knowledge. A third theory suggests that self-regulation is more of a skill set that is learned over the development of a child to an adult. As a skill, self-regulation could be improved with further knowledge and practice.

When discussing self-regulation in patients diagnosed with AD/HD, most research falls into the second category discussed by Baumeister (2003), treating self-regulation as a cognitive process and the failure to regulate as a cognitive defect. Research has established that, in many cases, AD/HD is likely the result of an EF deficiency (Barkley, 2004). If this is the case, then very little can be done to correct this dysfunction, and self-control can only be assisted with treatments like stimulant medication. Another one of the popular areas of self-regulation research holds more potential for alternative treatments of AD/HD.

Self-Regulation, Ego Depletion and Glucose

One theory of self-regulation assumes that this control is a matter of willpower in the sense that cognitive and physical resources are required to resist a temptation or perform an unenjoyable activity. Much like limited capacity models in cognitive psychology, will power is a limited resource that can be drained by performing tasks. Under this assumption, self-regulation could be strengthened by providing the brain with more resources (i.e. glucose) to expend while self-regulating. Multiple studies have explored all three potential domains of self-regulation using various approaches, but the aspect of self-regulation that is most applicable to the current study is the concept that willpower requires resources in order for most effective self-regulation. Indications that the self relies heavily on some resource have been found by many studies. A study by Baumeister, Bratslavsky, Muraven and Tice (1998) found that participants who were forced to eat radishes while surrounded by chocolate were quicker to give up on a subsequent unsolvable puzzle than a control group. Another experiment in the same study found that participants who were asked to suppress emotional responses to a funny or tragic video clip were less successful in solving anagrams than a control group told to express emotional responses. One study conducted by Muraven, Collins and Nienhaus (2002) found that when two groups of participants were offered beer prior to a driving skills test, the group that was not required to expend resources by solving arithmetic problems was less likely to choose to drink the beer, thus exercising stronger self-regulation. It would seem, then, that the same resources are required for many cognitive and social functions as those used when exerting self-control.

In an effort to determine what resources may be required for exerting self-regulation, Gailliot, et al., (2007) performed an experiment to test whether glucose might be the resource required for self-regulating behavior. Two groups were subjected to several tests of self-control (i.e. Stroop tasks, suppression of thoughts, suppression or expression of emotion, and control of attention), after which blood glucose levels were measured using a standard diabetic Accu-Chek meter. These measurements indicated that those participants told to focus their attention on a single detail of a video during the self-control tests experienced a drop in blood glucose that was significant both within and between-participants when comparing the focused attention and non-focused attention group. After several similar experiments within the same study were used to further support those findings, another experiment was used to determine if more resources could be added in order to increase self-regulating behavior. Two groups of participants were given lemonade sweetened with either sugar (glucose) or an artificial sweetener (which would not impact blood glucose) and given a non-related survey for twelve minutes to allow the glucose to be metabolized. The participants in the glucose condition performed better and faster on Stroop tests than the placebo group.

Studies on self-regulation, especially the Gailliot, et al., (2007) study's indication that self-regulation can be improved short-term with the increase of glucose available in the blood, could prove useful as a potential treatment for the management of AD/HD symptoms and behavior. The current study will use these findings to guide some of the methodology when examining participants with AD/HD. Because it has been indicated that glucose availability in the brain leads to increased self-regulation (Gailliot, et al., 2007) and that stimulant drugs lead to an increase in metabolism in the cerebellum (Ernst, et al., 1994; Volkow, et al., 1997), the following hypothesis and research question are proposed:

H_8: Resources available for encoding will be higher for video clips viewed after the administration of glucose for both groups, resulting in more accurate responses on the signal detection tests.

RQ_3: Will there be changes in HR in either group while viewing video clips after the administration of glucose?

RQ_4: Will there be changes in the number of SCRs in either group while viewing video clips after the administration of glucose?

RQ_5: Will post-glucose recall in diagnosed participants be comparable to pre-glucose recall of non-referred participants?

CHAPTER 5

METHODOLOGY

Three studies were included in this dissertation. These studies included a pilot study intended to assess the aversive and appetitive nature of video clips used for the final experiment, a screening survey for the identification of the prevalence of AD/HD symptoms and recruitment for participants, and the final experiment. Each methodology is described in detail below.

Pilot Study

To ensure that the stimulus clips used in the final experiment were effectively categorized as aversive or appetitive, a pilot study was conducted to determine which clips were most appropriate for use in the final study.

Participants

27 participants were recruited from an upper level undergraduate course in a mass communication department at the University of Alabama. Participants were over the age of 19 and received extra credit in exchange for participation in this study. Demographic information outside of gender was not collected for this phase of the study.

Stimulus Clips

The stimulus clips used in the pilot study were chosen based on whether the researcher felt that they had the potential to be rated by participants as highly appetitive or highly aversive in nature. The 32 stimulus clips used in the pilot study were drawn from various sources including commercials, entertainment television programming, and news programming. Although commercials and feature length films are frequently used in LC4MP studies, this variety of sources was included in an attempt to account for confounding variables as a result of stylistic features associated with certain genres. Feature length films have been excluded from the sample because this genre is stylistically different from commercials and television formats, which would be the most similar formats to potential educational videos. Stimulus clip length fell between 30 and 45 seconds in order to avoid confounding variables resulting from habituation or loss of attention as a result of significant differences in length of time viewed.

Topics of the video clips included aversive visuals such as humans being attacked by wild animals, parasitic disease, rotting food and unsanitary kitchen conditions, children carrying guns, and similar negative visuals. These were based on the International Affective Picture System (IAPS) and the visuals that were indicated by participants in the system's research to be unpleasant. Based on the same system, a series of clips were chosen based on their appetitive visuals – attractive women in seductive situations, expensive cars, visuals of money, and similarly appealing visuals. The list of chosen video clips and a brief description of each is included below.

The clips were formatted in a continuous series on a single DVD in a random order. They were be separated by twenty seconds of black to allow participants enough time to complete the response scales outlined below. The entire series lasted approximately 26 minutes.

Scale

The scale for the pilot study was developed by the researcher using a typical semantic differential construction in order to assess the appetitive or aversive nature of specific video clips chosen for the final study. Traditionally the IAPS uses the Self-Assessment Mannequin (SAM) for rating still visuals that are included in the system. Although the SAM was used during the experimental study, a new scale based on similar principles was used for assessment of stimulus clips during the pilot study. A five-item seven-point semantic differential scale was devised with the following word pairs: disgusting/appetizing, disturbing/comforting, unenjoyable/enjoyable, frightening/nonfrightening, unattractive/attractive. Lower scores indicate a more negative reaction, while higher scores indicate a more positive rating of the video clip in question.

Procedure

In order to ensure that the video clips chosen by the researcher were accurately categorized as appetitive or aversive by a group of participants that were similar in age to the sample population that was used in the final experiment, the pilot study was conducted on 27 undergraduates enrolled in an upper-level mass communication course in the Fall of 2010. Participants were recruited during a class period and were given the opportunity to participate in this pilot study during the class meeting. All students were over the age of 19 and no student declined participation.

Once participants had read the consent form, they were given the scales described above and the instructions were given orally to ensure that participants understood how to accurately respond using the scales. Participants were instructed not to speak aloud during the clip viewing, and to refer to their first impression of the clips when rating them. The researcher then dimmed the lights and projected the stimulus clips onto a classroom projector. Audio was wired into the classroom and was adjustable by the researcher throughout the presentation. Participants rated each clip upon its completion in the 20-seconds of black between each of the clips. Once this process was completed participants were debriefed and dismissed.

Screening Survey

Because the overall goal of this study is to identify key differences in mediated message processing between a group of individuals diagnosed with AD/HD and a control group of non-referred participants, a screening survey was necessary in order to accurately identify individuals that fall into each of the two groups, as well as to serve as a means of recruiting those individuals most suitable for the final experiment.

Participants

In order to have the widest access possible to a pool of participants qualified for both the diagnosed and non-referred groups, 519 students were recruited from the College of Communication and Information Sciences participant pool as well as other communication courses. Because there is a relatively high incidence of AD/HD in the general population, even in adults age 19-25, and the requirements for participants in the final experiment was low, the use of minors in the sample was deemed unnecessary by the researcher, so all participants were age 19 or older as required in the state of Alabama.

Participants were recruited through several courses in the College Communication and Information Sciences at the University of Alabama. These courses included two introductory level mass communication lecture courses, one introductory level telecommunication and film lecture course, two upper level telecommunication and film courses, one upper level journalism course, and one upper level communication studies course.

Survey

The screening survey was developed by the researcher using items from an adult AD/HD survey and questions specifically regarding the student's diagnosis (or lack thereof) and any current stimulant drug therapy. The adult AD/HD items were taken from a popular diagnostic survey developed by Jasper and Goldberg (2006) and were intended to give the researcher an indication of whether survey takers exhibit symptoms of AD/HD. This survey contains 24 items with six possible responses (not at all; just a little; somewhat; moderately; quite a lot; very much) which are scored according to a rubric specified by the creators, with an answer of "not at all" resulting in 0 points ranging to "very much" scoring 6 points (See Appendix A). A score of 70 points or more is a strong indicator of AD/HD symptoms and was used in conjunction with other medical information asked in the screening survey to determine participant's eligibility for inclusion in final experiment. When recruiting non-referred participants, scores on the screening survey were used to select participants who had no possibility of undiagnosed AD/HD. Scores ranging from 27 to 55 qualified participants for this study. Those scoring less than 27 were eliminated because it is likely that those participants were simply answering questions quickly to obtain credit and the score did not accurately reflect their ability to focus attention or control inappropriate behaviors associated with the disorder.

Beyond scores on the Jasper and Goldberg (2006) diagnostic survey, medical information about the participant's diagnosis and current treatment was obtained through self-report open-ended questions. Due to the half-life, dosage, and specific symptoms associated with medications used to treat AD/HD, survey participants were asked to list all prescription medication that they were taking during the period of the survey. Based on these responses, certain participants would be eliminated due to the specific medication or medications prescribed to them. A list of acceptable medications for this was compiled by a physician consultant and is included in Appendix B.

It is important to note that this screening test is only an indication of symptoms and not a complete diagnosis, which would require other information about the participant's educational/career and home lives. Instead, this survey was intended to ensure that those participants who have been diagnosed fall beyond the threshold score desired and that participants that fall into the non-referred group fall below the threshold score desired for that group (less than 55 points). Because many cases of AD/HD go undiagnosed due to different manifestations of symptoms, especially in women and girls (Biederman, 2005), this screening survey was used to ensure that participants considered non-referred based on other responses do not fall into the AD/HD category, thus confounding data later in the experimental portion of the study.

Procedure

The survey was posted online at a professional survey management site for ease of participant access. After completion of the survey questions participants were required to give their names in order to receive credit and were advised that there was a possibility they would be contacted via their school e-mail accounts at a later time for a follow up study. Responses were collected over the span of three months in the Fall 2010 and Spring 2011 semesters.

During data collection individuals were identified based on scores for the final portion of the study proposed. Follow-up e-mails were sent to those individuals identified by the researcher in which they were given a brief description of the experimental portion of the study as well as offered monetary compensation for their participation in the study. Participants whose scores fell within the desired range were contacted until 20 participants for each group (AD/HD and non-referred) were scheduled for and completed the experimental portion of the study.

Experiment

The experiment for this dissertation utilized a 2 (aversive or appetitive valence) X 3 (slow, medium, or fast pacing) X 12 (video clips) within-participants design. It also utilized a 2 (diagnostic condition) X 2 (pre or post-glucose) between participants design.

Participants

A total of 41 participants were recruited for the experimental portion of this study. 21 AD/HD and 20 non-referred participants were recruited using the procedures outline above, and the data from one AD/HD participant was eliminated from the final analysis due to experimental error. All participants were students enrolled at the University of Alabama during the Spring 2011 semester.

Of the 40 participants whose data was used for this study, the mean age was 20.40 years old. 30 % (n = 12) of participants were male, 70% (n = 28) were female; according to their self-reported data, 77.5% (n = 31) were Caucasian, 12.5% (n = 5) were African American, 5% (n = 2) participants were Hispanic, 2.5% (n = 1) of participants were Asian American, 2.5% (n = 1) were "other" and reported being of Middle Eastern descent, and 2.5% (n = 1) preferred not to say. These

For the AD/HD participants, the mean age of diagnosis was 6.9 years of age, but responses ranged from 6 years of age to 21 years of age. 8 of the 20 participants reported taking their stimulant medication daily, 5 reported taking it 3 to 5 days out of every week, 2 reported taking it a few times a month, 1 reported taking it ten times a year, and 4 reported taking their medication only for specific projects. Most of the AD/HD participants (n = 12) self-reported they could not perform well on monotonous or time consuming tasks without their medication, 4 were uncertain, and 4 felt they could perform well on tasks without medication.

Manipulation Check

A Stroop Color-Word Task was used as a manipulation check in this study. This task is traditionally used to indicate the ability of the participant to overcome interference (Golden, 1978). There are several different versions of the Stroop Color-Word Task, the most common being the "Golden" version. In this task, participants are asked to read three different cards according to certain instructions. On the first card is printed rows of color names written in black ink. The next card is several rows of Xs printed in different colors. During this card, participants are asked to name the colors of the Xs. The third and final card is the one that assesses interference and the ability to control cognitive resources. On this card a series of color names are written in different colors, the word "RED" may be printed in green for example, and participants are asked to name the color that the word is printed in, not the color that the word names.

The Stroop-Color Word Task is especially appropriate for the group of participants identified for this study. Interference control is one of the processes controlled by the EF, and that control seems to be lacking in those diagnosed as AD/HD (Barkley, 1997). Because of this telltale lack of interference control, Stroop Color-Word Tasks are recommended as part of the psychological tests used to clinically diagnose the disorder (Doyle, Biederman, Seidman, Weber & Faraone, 2000). Therefore it should be expected that if participants with diagnosed AD/HD have refrained from prescribed medication they should score significantly lower on the Stroop Color-Word Task than the non-referred participants. Additionally, this task serves as a means of "draining" resources required for self-regulation as has been discussed earlier in the literature review, and will ensure that all participants have had the same amount of mental exertion required just prior to participation.

The version of the Stoop Color-Word Task used for this experiment is a variation on the final stage of the traditional Golden version of the test. Participants were given the test on a laptop. In this version of the test, words and colors are presented randomly. The participant must indicate with the keyboard what letter the color of the word begins with (not the color named in the text itself). Participants were given a trial period of two minutes (approximately 50 words) to give them a chance to become comfortable with the test requirements before they participated in a 40 word series.

Independent Variables

Valence. Video clips used in this study were categorized by aversive or appetitive valence according to the scores from the earlier pilot study (these clips are discussed at length on p. 69). As indicated in the study by Wik, et al., (1993), appropriate visual stimulation can result in a fear response, which triggers an increase in activity in the cerebellum and SNS. Aversive clips were used in an effort to trigger this physical response, resulting in faster HR and an increase in metabolism.

Appetitive visuals, on the other hand, have been associated with limbic regional responses, specifically responses in the amygdala (Hamann, Herman, Nolan & Wallen, 2004). The amygdala is thought to be involved in the motivation system, initially intended to help preserve primitive humans by enforcing the desire for food, sex, and other beneficial environmental stimuli (Aggleton, 2000). The appetitive clips are intended to appeal to this response.

Beyond these physical responses, valence of stimuli can also result in the allocation and consumption of cognitive resources. A study by Lang, et al., (2007) indicated that recall was greater for clips with negative valence than positive or neutral valences.

Pacing. Because a great deal of AD/HD symptoms are likely a result of dysfunctional EF performance, the consumption of resources is a key element in the study of AD/HD cognitive processing of mediated messages. Along with valence, pacing of a program can also result in the consumption of cognitive resources. According to a study by Lang, Bolls, Potter and Kawahara (1999) medium pacing in conjunction with emotionally arousing content results in maximum recall of information, while faster pacing under the same conditions results in cognitive overload and thus failure to recall information. Pacing is determined by counting the number of edits in a 30 second time period. An edit is considered any change in camera location, subject, location of shot, etc (Lang, et al.., 2000).

To manipulate pacing in this study, the researcher edited all clips in order to generate the appropriate number of aversive and appetitive clips at slow, medium, and fast pacing. Pacing was determined by referring to Lang, et al., (2006) operationalizations of pacing. According to this study, fewer than four edits would be considered slow pacing, five to nine edits would be considered medium pacing, and more than ten edits per 30 seconds would be considered fast pacing. Originally, however, these assignments were given to movie clips, which can naturally move at a slower pace than commercials of the same length. In the interest of making stimuli material as realistic as possible to create a more natural setting, these standards were slightly altered by the researcher. Instead, slow pacing for this study was defined as fewer than six edits, medium pacing between nine and eleven edits, and fast pacing was greater than fourteen edits in a 30-second period.

Dependent Variables

Signal detection tests were used to assess participants' self-report responses to clips and the effectiveness of the encoding and storage of information during clip viewing.

Self-Assessment Mannequin. The SAM is a self-report system intended to provide participants with a more emotionally accessible and somewhat culturally universal means of expressing their arousal, emotional response, and feelings of control (Morris, 1995). These three items are represented by visual demonstrations in the form of cartoon men with illustrative details indicating the response in question. In this study the SAM was used by participants to assess themselves on those three dimensions and used at a later time to compare to physiological data to determine any disparities between the AD/HD and control groups' self-assessment and physiological data. This self-report measure was used in order to determine how AD/HD individuals perceived the videos they were watching.

Visual signal detection. A visual signal detection test was given to participants. In signal detection, participants must assess whether a signal was present or not based on a brief visual cue (Van Der Heijden & Eerland, 1973). Signal detection is used to assess the strength of encoding (and thus the available cognitive resources) while viewing the video clips.

In order to conduct the visual signal detection test, two images were taken from the clips shown in each series. A set of two "doppleganger" images were also taken from excess footage or similar programming for each of the clips for a total of forty-eight images (four for each of the twelve clips). An individual visual signal detection test was created and executed for each of the two series. These images were inserted into a video and preceded by its image number (to allow participants to track their progress on the paper response sheet), then were shown for four frames (approximately $1/6^{th}$ of a second) and then replaced with a black screen indicating the number of the upcoming image.

Participant responses were assessed for correct rejection (correctly saying that they did not see an image during the video clips), false alarms (incorrectly saying that they saw an image during the video clips), misses (incorrectly saying that they did not see an image during the video clips), and hits (correctly saying that they saw an image during the video clips), and analyzed.

Auditory signal detection. Auditory signal detection is similar to visual tests except that cues are given in audio and not visual form (Swets, Tanner & Birdsall, 1961). Although auditory signal detection is not common in communication methodologies, cognitive learning research has indicated multiple sensory stimulation environments can lead to better processing and storage of information for long-term retrieval (Bahrick & Lickliter, 2002). Because the ultimate goal of this study is to determine features effective for educational videos targeted at AD/HD students, it is important to determine if audio is a more effective memory cue than visuals. Like the visual signal detection, an audio sound bite was taken from each clip, as well as one "doppleganger" audio sound bite, for a total of 24 sound bites. Length of audio clips ranged from one to three seconds, depending on the length of time that could encompass three words or three measures to allow for identification.

Participant responses were assessed for correct rejection, false alarm, misses, and hits, and data was analyzed.

Physiological data as indicators of dependent variables. Physiological measures are used less often in the communication field than in psychology, but these measures can contribute to this field as well. One of the strengths of physiological measures is that they are more objective than a participant's self-report. Physiological responses are difficult to control for the most part, and so participants are not able to give the responses they think researchers want, or responses that they are afraid to give because of social desirability associated with certain answers. At the same time, there is a limit to what physiological measures can assess, as these measures are not capable of reading thoughts.

Physiological responses are especially useful for the examination of information processing because they give information about nervous system activity that participants cannot self-report. These responses can relay information about attention, arousal, perception, and enjoyment. Most often, communication studies using physiological measures are interested in how attention, arousal, and structural features can impact cognitive resources and processing of messages. This research could be applied in the field of advertising and marketing strategies and possibly applied to educational media.

Heart rate and attention. When studying concepts such as “attention”, it is important to accurately define and present a means for measuring that concept. Attention can be defined theoretically as the applied focus of cognitive resources to the stimuli presented. Operationally, attention is most easily determined in psychophysiological studies with the observation of changes in heart rate (HR). A decrease in HR is an indication that the participant is currently focusing on the stimulus presented. In studies on general attention to the environment, several other measures were used. Fantz (1964), for example, determined that infants between two and six months old were able to pay attention (in the theoretical sense) by observing eye movement patterns when a familiar figure (the infant’s mother) or a strange figure was brought into the room. A pattern of habituation as evidenced by gaze length began to form that would be similar to that of an adult and suggested the infants were focusing cognitive resources into encoding, storing, and retrieving facial patterns for recognition at a later time. Lang (2000) uses both physiological HR data and recall tests to determine whether encoding, storage, and retrieval occurred as a result of attention to stimulus clips.

One of the more common types of physiological measurement used is electrocardiogram (ECG), which measures heart rate (HR) and heart period (HP) (Andreassi, 2007). HR is a measure of beats over a period of time (typically over 30 seconds), which can be measure in beat per minute (BPM). The study of HR is best for longer period of time, such as those over 30 seconds. HR is often also used to generally refer to the data collected by ECG. HP, on the other hand, is measured by determining interbeat interval (IBI), or measuring the distance from the crest of one HP wave to the next. HP is better for shorter data collection periods (under 30 seconds) because it gives a more detailed view of changes in heart beat activity. Both HR and HP can indicate several different mental processes. A sudden decrease in HR or HP indicates an orienting response (OR), or sudden focused attention of the participant to the stimuli. Continuation at this decreased pace indicates that cognitive resources are being focused on the stimuli for that period of time. An increase in HR is an indication of a defense response (DR), or the activation of the participant's "fight or flight" response. HR or HP, therefore, can indicate both attention and arousal and which is occurring must be determined by the researcher based on the waveforms displayed and the stimuli presented at the time of the response.

In order to properly collect HR data, electrodes must be placed on the participant's arms. The dominant arm will have one grounding electrode (to allow use of that arm in case of collection of self-report data), while the other arm will have two electrodes that will send data in the form of electric pulses back to the module that will interpret those pulses and display an analog waveform for analysis. Prior to attaching electrodes, the areas for attachment will have to be cleaned thoroughly and abraded to remove interfering dead skin cells using sterile alcohol wipes (or distilled water in case of allergy or sensitivity). The skin in those areas should be very red but not bloody, as breaking the skin risks infection for the participant. This electrode placement is best for standing or sitting participants. There are a few ways in which the data from the participants can be "tampered" with, which is a drawback of this measure. Participants can affect HR, for example, by holding their breath. Interference can also occur if participant moves too much, which will make data difficult to clean and analyze.

In this study, HR was monitored while participants viewed video clips in order to assess both attention and arousal. Arousal, indicated by an increase in HR, was monitored as it is also an indication of heightened metabolism in the body (Hargreaves & Spriet, 2006).

Skin conductance responses and arousal. Another common physiological measure is the skin conductance response (SCR), which measures electrodermal activity (EDA) by recording and relaying the conductivity of electrical activity in the skin (Andreassi, 2007). The eccrine glands are found nearly all over the human body and excrete sweat when an individual is nervous or aroused. Eccrine glands are found most densely in the palm of the hands and the sole of the feet, so electrodes are generally placed on the hand. As the eccrine glands become more active, more conductance is detected and that information is displayed in an analog form after conversion. An SCR is a sudden increase in EDA that marks a response to some stimuli, and the frequency of SCRs can be used to determine levels of arousal as a result of stimuli in research.

To prepare a participant for EDA, a similar method of cleaning and abrading is necessary as used in ECG. The non-dominant hand was used for electrode placement (again to allow for relatively free movement of the dominant hand). Electrodes can be placed either around the tips of the middle and ring finger, or across the thicker pads of the bottom of the palm (preferred). Like ECG, EDA can be affected by outside variables. Temperature of the room, for example, must be controlled throughout an experiment in order to ensure that an SCR is not a reaction to changes in environment, as one of the primary purposes of the eccrine glands is to assist in maintaining temperature in the body. Also like ECG, movement of the participant's hand can result in messy and difficult to analyze data.

For this study the frequency of SCRs were used to indicate arousal while viewing clips. These were also an indication for an increase in metabolism.

Stimulus Materials

Using the clips assessed in the pilot study outlined earlier, two different series of video clips were produced, one for participant viewing prior to the administration of glucose in the form of a small snack, and one for participant viewing following the metabolism of the glucose. Each series featured twelve clips lasting between 30 and 45 seconds in length. Between each clip was a 15-second countdown clock to allow for participant responses using the SAM.

Each clip series contained six aversive and six appetitive clips (these clips are outlined in detail below). For each set of clips (aversive or appetitive) there were two clips for each of the three levels of pacing. For example, there were two aversive clips that are slow paced, two that were medium paced, and two that were high paced, with the appetitive clips falling into the same categories. Order of clips was randomized and order of series was also randomized between participants to account for any confounding variables as a result of order.

Although in previous studies the product or topic of a commercial or television excerpt has not been accounted for, the stimulus clips involved in this study have been paired with another clip advertising or discussing the same product, brand, or topic. For example, if there was a news report regarding a disease in the first clip series, there was a news report discussing a similar (but slightly different) disease in the second clip series. Once stimulus clips had been chosen based on participant ratings, clips that discuss the same topic were divided one each into the pre-glucose and post-glucose clip series. This was done in an attempt to eliminate confounding variables as a result of personal interest in a topic or brand. If recall is greatest for both clips of the same brand or topic, it is likely that a confounding factor was involved. Obviously not all cues can be eliminated as there is not an in-depth background examination of each participant, but this method allowed the researchers to account for any instances of this occurrence.

In order to accurately assess the aversive or appetitive nature of clips, as well as the degree to which these clips were considered by participants to be "aversive" or "appetitive", clips reviewed by participants in the pilot study were chosen based on ratings. Selection criteria are discussed at length in the pilot study section of the results chapter. These clips are outlined in the next two sections, along with approximate runtime, average score on the pilot test scale, and standard deviation. Lower scores denoted more aversive nature, higher scores indicated appetitive nature, with a score of "4" being neutral. These clips were then edited to control for pacing and divided into series as outlined above.

Aversive clips.

Rwanda Genocide (:40) (M = 1.28; SD = .15) This historical clip reviews the controversy surrounding the genocide in Rwanda and includes relatively graphic pictures of dead and maimed men, women, and children.

Haiti Aftermath (:41) (M = 1.46; SD = .39) News coverage of Haiti approximately 24 hours after the initial earthquake. This clips discusses a 13 year old girl trapped under rubble (later rescued in the context of the clip) and scenes of rescue efforts.

Don't Text and Drive (:34) (M = 1.49; SD = .34) A European public service announcement that has been used limitedly in defensive driving courses in the United States. This clip shows a massive car accident resulting from a teen driver texting on her cell phone.

The clip includes the death of passengers in the teen's car and other vehicles as a result of the accident.

Monsters Inside of Me: Maggots (:42) (M = 1.54; SD = .45) A clip taken from a program on Animal Planet that discusses a man's discovery that he has become the host of maggots. Includes footage of maggots in a sterile environment and in open wounds on animals.

Kitchen Nightmares: Roaches in the Refrigerator (:31) (M = 1.63; SD = .35) A clip taken from a program on the FOX network hosted by chef Gordon Ramsey. This clip features footage of a restaurant refrigerator filled with cockroaches and food that is moldy and rotten.

Kitchen Nightmares: Rotten Food (:31) (M = 1.75; SD = .49) A clip taken from a program on the FOX network hosted by chef Gordon Ramsey. In this clip there is footage of rotten and moldy food as well as dripping moldy water in the walk-in freezer of a restaurant.

Monsters Inside of Me: Botfly Maggots (:34) (M = 1.85; SD = .32) A clip taken from a program on Animal Planet that discusses botfly maggots. This clip includes footage of large amounts of maggots and flies.

Sudan Genocide (:30) (M = 1.87; SD = .31) This mini-documentary clip discusses one U.S. Marine's experiences with the genocide in Darfur. It includes footage of dead and maimed men and women.

China Kidnapping (:36) (M = 2.26; SD = .44) This news report by *The New York Times Online* discusses the increase in kidnapping of young boys from parents in China to sell to other families.

Wear Your Seatbelt (:36) (M = 2.27; SD = .32) A European public service announcement that discusses the importance of wearing a seatbelt. This clip features footage of a car accident and the resulting injuries and deaths as a result of not wearing a seatbelt in a collision.

Bridge Collapse (:38) (M = 2.33; SD = .87) A clip taken from a program on The Weather Channel discussing the potential dangers of a large earthquake in San Francisco, California. This clip features the collapse of a bridge, car falling into the bay below, and an underwater subway cut off from electricity resulting from the hypothetical earthquake.

Tsunami (:45) (M = 2.77; SD = .71) Footage of the Southeast Asian Tsunami as it arrives onshore in various locations. Includes footage of victims running from the tsunami and the damage resulting from the rising water levels.

Appetitive clips.

Cottonelle Puppy Tissue Test (:30) (M = 6.04; SD = .73) A commercial featuring a golden retriever puppy and twin girls using the product and a competitor to clean the puppy.

Cottonelle: Be Kind to Your Behind (:30) (M = 5.89; SD = .66) A commercial featuring a golden retriever puppy running through a park and playing with people.

State Farm: Cash (:30) (M = 5.38; SD = .53) A commercial featuring images of money and the suggestion that more money would result from using State Farm's service.

Jenny Craig: Valerie Bertinelli (:30) (M = 5.36; SD = .56) A Jenny Craig commercial featuring Valerie Bertinelli in a bathing suit.

Michael Bay's Victoria's Secret (:34) (M = 5.35; SD = .64) A special Victoria's Secret promotion directed by Michael Bay including shots of models in bikinis taking part in risky behavior (shooting guns, throwing knives, riding motorcycles, etc.).

Jenny Craig: Nicole Sullivan (:30) (M = 5.32; SD = .52) A Jenny Craig commercial featuring Nicole Sullivan in a bikini.

Victoria's Secret Confessionals (:30) (M = 5.27; SD = .58) A Victoria's Secret mini-documentary in which underwear clad models discuss what they find attractive in a man.

State Farm: Cars (:30) (M = 5.21; SD = .62) A commercial featuring images of expensive cars.

Tuscan Car Review (:41) (M = 5.19; SD = .62) A BBC program report on a sports car.

Carl's Jr.: Padma Lakshmi (:33) (M = 5.19; SD = .68) A commercial in which Padma Lakshmi wears revealing clothing while seductively eating a hamburger.

Calvin Klein Envy (:30) (M = 5.19; SD = .72) A commercial in which Zoe Saldana discusses her personal secrets while dressed in underwear.

Carl's Jr.: Kim Kardashian (:) (M = 4.88; SD = .49) A commercial in which Kim Kardashian wears revealing clothing while seductively eating a salad in her bed, then in the bathtub.

Procedure

Participants diagnosed as medicated AD/HD and identified through the screening survey were asked to refrain from taking their stimulant drug medication at least 18 hours prior to participating in this study in order to remove confounding variables due to differences in prescribed dosages, effects of medication, and similar concerns. This brief drug holiday also gives a more accurate view of attention, arousal, and recall in participants with AD/HD without the management of stimulant drug therapy. As outlined in the screening survey, precautions were taken to ensure that participants would not suffer academic or health issues as a result of abstaining from stimulant medications.

Participants were brought into the lab and filled out a consent form. During this time researcher or research assistant completed initial information on the participant data sheet. As a manipulation check, a modified Stroop Color-Word Task was given on a portable laptop computer owned by the researcher. Participants were given a two-minute practice period to ensure their comfort with the requirements of the task and then took part in a forty word series. This process was monitored by the researcher to ensure there were no complications with the software, and data was collected upon completion of the trials and recorded onto participant data sheet.

Electrodes were placed on the arms and hands of the participant to collect data for HR and EDA, and software and calibration was conducted to ensure properly working equipment. Participants were instructed to view the clips that were shown on the television in front of them and advised that they would be asked questions about the clips after the entire series had been completed. They were then given the SAM and instructed in its use. After the researcher was confident that the participant understood the instructions, participants were left in the room and viewed by researcher through a two-way mirror. Video clips were controlled remotely and played on a television screen in the room with the participant. Volume of clips was controlled for all participants.

As participants view the clips, HR, and EDA data was collected and associated with the individual clip the participant was viewing at that time for use later during analysis. Data collection using the Biopac equipment and software was stopped at the end of each clip and resumed at the beginning of the following clip as the participant's movements while using the SAM would create a great deal of interference in the data collection and make analysis more challenging.

When the first series was completed, the researcher re-entered the room and the participant was given glucose in the form of a juice drink. Participants were given a choice of one of four drink flavors produced by a major distributor. All drinks were 177 mL containers with 70 or 80 calories and 19 or 20 grams of sugars and all participants were required to finish the entire drink. Several flavors were chosen in order to avoid complications in the procedure as a result of allergies or personal preferences in the participants. After consumption of the drink was completed, the researcher gave the participants the signal detection post-tests. To conduct the post-tests, participants told the researcher out loud whether or not they had seen or heard the image or sound bite presented. This was to reduce the amount of movement that would occur for written responses, which would have been difficult for the participant and may have resulted in the removal of the electrodes in some cases. The signal detection tests gave the participants a little over ten minutes for metabolizing the glucose before the next series of clips. After completion of the tests, participant resumed viewing clips and used the SAM following the same procedures as the first set of clips. Once the second video series was completed, the second series of post-tests were administered in the same manner as before.

After completing the final signal detection tests, the sensors were removed, the participant was debriefed and reimbursed and then dismissed. The entire study took approximately one hour to complete.

CHAPTER 6

RESULTS

Pilot Study

After the collection of data was completed, responses were transcribed and analyzed for mean and standard deviation. In the case of four clips, participants chose not to fill in responses, resulting in only 26 evaluations for each of those clips, marked in Table 6.1 (p. 76).

Stimulus Clip Selection

Stimulus clips for the final experiment were chosen based on the evaluations from the pilot study. Twenty-four clips were necessary for the experiment, so eight had to be removed from the initial sample. In order to eliminate the eight clips that would be least effective for this study, clips were evaluated first for their total mean. Clips with highly aversive or highly appetitive total scores were selected first. Those clips with total means closest to 1 were considered highly aversive, while those with total means closest to 7 were highly appetitive. These clips were then cross-checked for each individual score to ensure that none of them had a dramatically different rating than would be expected. The appetitive clips, for example, were cross checked to verify that the individual item scores all fell above 4 (the neutral score), while the aversive clips were cross checked to verify that all individual item scores were below 4. No clips were eliminated during the cross-reference. Twelve aversive and twelve appetitive clips were chosen and used in the final experiment.

Table 6.1
Participant Ratings of Clips on Five Dimensions

Clip	*Disgusting* M*(SD)*	*Disturbing* M*(SD)*	*Unenjoyable* M*(SD)*	*Frightening* M*(SD)*	*Unattractive* M*(SD)*	*Total* **M***(SD)*
Wear your Seatbelt	2.07*(.95)*	1.89*(.85)*	2.19*(1.08)*	2.07*(.96)*	2.48*(1.34)*	**2.27***(.32)*
Child Soldiers	3.63*(.83)*	2.33*(1.21)*	2.56*(1.12)*	3.00*(1.47)*	2.92*(1.27)*	**2.87***(.86)*
Maggots	1.07*(.95)*	1.37*(.79)*	1.67*(1.07)*	2.26*(1.51)*	1.33*(.73)*	**1.54***(.45)*
Shark Attack	3.26*(1.06)*	3.07*(1.14)*	3.67*(1.36)*	3.52*(1.60)*	3.41*(1.28)*	**3.39***(.23)*
MX v ATV	4.30*(1.75)*	4.48*(1.65)*	4.41*(1.97)*	5.78*(1.65)*	4.56*(2.03)*	**4.70***(.61)*
Michael Bay VS	4.78*(1.60)*	4.85*(1.35)*	5.15*(1.56)*	6.33*(1.33)*	5.63*(1.47)*	**5.35***(.64)*
State Farm Cash	4.74*(.94)*	5.26*(1.16)*	5.52*(1.28)*	6.19*(1.52)*	5.19*(1.24)*	**5.38***(.53)*
Tuscan Car	4.89*(1.01)*	4.74*(.98)*	4.85*(1.63)*	6.26*(1.16)*	5.19*(1.44)*	**5.19***(.62)*
*San Diego Fire**	3.96*(.23)*	3.00*(1.12)*	3.46*(1.12)*	2.92*(1.33)*	3.46*(.76)*	**3.36***(.42)*
*Roaches in Fridge**	1.27*(.68)*	1.42*(.90)*	1.81*(1.30)*	2.23*(1.53)*	1.42*(.84)*	**1.63***(.35)*
*Leopard Attack**	2.85*(1.18)*	2.31*(1.02)*	2.92*(1.64)*	2.46*(1.64)*	3.04*(1.27)*	**2.72***(.31)*
China Kidnapping	2.93*(1.21)*	1.74*(.94)*	2.22*(1.25)*	2.04*(1.34)*	2.37*(1.24)*	**2.26***(.44)*
*Kardashian Salad**	4.50*(1.83)*	4.50*(.96)*	4.65*(.96)*	5.65*(.96)*	5.08*(1.41)*	**4.88***(.49)*
PS3 v. Wii	4.07*(1.66)*	4.30*(1.71)*	4.85*(1.68)*	5.70*(1.73)*	4.52*(1.89)*	**4.69***(.64)*
Extra $20,000	4.19*(.56)*	4.41*(.75)*	4.63*(1.15)*	5.74*(1.40)*	4.52*(1.12)*	**4.70***(.61)*
Valerie Jenny Craig	4.70*(.99)*	5.26*(.94)*	5.30*(.99)*	6.26*(1.13)*	5.30*(1.07)*	**5.36***(.56)*
Bridge Collapse	3.63*(.79)*	1.63*(1.01)*	2.22*(1.31)*	1.48*(.75)*	2.67*(1.21)*	**2.33***(.87)*
Don't Text and Drive	2.04*(1.13)*	1.15*(1.13)*	1.33*(.78)*	1.37*(1.18)*	1.56*(.97)*	**1.49***(.34)*
Rotten Food	1.26*(.53)*	1.56*(.89)*	1.78*(1.19)*	2.56*(1.97)*	1.59*(.97)*	**1.75***(.49)*
Botfly Maggots	1.52*(.84)*	1.67*(.96)*	2.11*(1.40)*	2.26*(1.53)*	1.70*(1.03)*	**1.85***(.32)*
Lakshmi Burger	1.98*(.68)*	4.30*(.85)*	5.22*(1.65)*	6.19*(1.49)*	5.26*(1.34)*	**5.19***(.68)*
Nicole Jenny Craig	4.70*(.99)*	5.33*(1.04)*	5.26*(1.20)*	6.15*(1.29)*	5.15*(1.20)*	**5.32***(.52)*
State Farm Cars	4.70*(.99)*	4.96*(.90)*	5.26*(1.58)*	6.26*(1.13)*	4.96*(1.26)*	**5.21***(.62)*
VS Confessionals	4.70*(1.51)*	4.74*(1.51)*	5.22*(1.53)*	6.07*(1.64)*	5.59*(1.60)*	**5.27***(.58)*
Secret Obsession	4.04*(1.34)*	4.19*(1.44)*	4.48*(1.58)*	5.81*(1.47)*	4.93*(1.36)*	**4.69***(.72)*
Puppy Tissue Test	5.04*(1.22)*	6.26*(.98)*	6.48*(.80)*	6.85*(.46)*	5.59*(1.08)*	**6.04***(.73)*
Tsunami	3.59*(.93)*	2.15*(.99)*	3.30*(1.79)*	1.96*(.94)*	2.85*(1.35)*	**2.77***(.71)*
Rwanda	1.44*(.70)*	1.07*(.27)*	1.22*(.64)*	1.41*(.93)*	1.26*(.53)*	**1.28***(.15)*
CK Envy	4.41*(1.67)*	4.81*(1.73)*	5.07*(1.57)*	6.33*(1.21)*	5.33*(1.57)*	**5.19***(.72)*
Haiti Aftermath	2.07*(1.11)*	1.07*(.38)*	1.19*(.40)*	1.52*(.89)*	1.44*(.75)*	**1.46***(.39)*
Sudan	2.22*(1.12)*	1.37*(.63)*	1.89*(1.31)*	1.89*(1.01)*	1.96*(1.29)*	**1.87***(.31)*
Kind to Your Behind	4.96*(1.22)*	5.88*(.93)*	6.04*(1.02)*	6.81*(.62)*	5.74*(1.16)*	**5.89***(.66)*

**One case missing*

Screening Survey

A total of 519 participants were recruited for the screening survey. Because this was a screening test interested in determining whether or not individuals would qualify for the final experiment, very little demographic information was obtained, and the gender information was collected at the end of the survey, resulting in 4.8% (n = 25) of the participants failing to respond to that question. 34.5% (n = 179) were males and 60.7% (n = 315) of the sample were females.

Of those 519, 17.6% (n = 91) of the respondents answered that they had been diagnosed with AD/HD, 79.9% (n = 413) had not been diagnosed, 2.5% (n = 13) were unsure and .4% (n = 2) chose not to answer. Of the diagnosed, 39.6% (n = 36) were males, 53.8% (n = 49) were females, and 6.6% (n = 6) failed to respond. 81.3% (n = 74) of those diagnosed with AD/HD reported having been prescribed stimulant medication and 73.6% (n = 67) reported taking prescribed stimulant medication within the past six months.

All participants self-reported how much they felt they knew about AD/HD and if they felt they could identify the symptoms of AD/HD. These questions were asked both to report information about college students' awareness of the disorder and as a manipulation check for some of the information described later in this section.

As part of the screening process, all participants took the Jasper-Goldberg Adult AD/HD Screening Exam (Jasper & Goldberg, 2006). This screening exam is a preliminary means of determining if an individual shows signs of suffering from AD/HD but is not a diagnosis. Based on responses, a score ranging from 1 to 7 is added to a cumulative score on the exam. Individuals scoring above 70 on the exam may have AD/HD. In order to report these frequencies in the non-referred population, the researcher categorized the scores as follows: a score of 40 and below was labeled "Very Low Likelihood"; 41-55 was "Low Likelihood"; 56-70 was “Subthreshold”; 71-85 was “Threshold”; 86 and higher was “High Likelihood”. Score distribution for those who were not diagnosed with AD/HD is illustrated in Table 6.2. Twenty cases were eliminated due to unanswered items that resulted in an inaccurate score.

Table 6.2
Distribution of Jasper-Goldberg Screening Exam Scores in Non-Referred Participants

	Male (%)+	**Female** (%)+	**Total** (%)*+
Very Low	**32** (23%)	**54** (22%)	**92** (22%)
Low	**35** (26%)	**84** (61%)	**125** (31%)
Subthreshold	**25** (18%)	**44** (32%)	**73** (18%)
Threshold	**35** (26%)	**39** (28%)	**74** (18%)
High Likelihood	**10 (**7%)	**29** (12%)	**42** (10%)
Total	***137***	***250***	***406****

**Total includes cases with unreported gender*
+Total percentages may not equal 100 due to rounding

Of note is that 10% (n = 42) of the sample was highly likely to have AD/HD based on their self-reported responses, and approximately 28% (n = 116) of the sample fell above the threshold of adult AD/HD scores. Also of note is that 12% of females fell into the “High Likelihood” category, while only 7% of males did.

Experiment

Manipulation Check

In order to ensure that participants were AD/HD and had refrained from medication as requested, scores for a Stroop Color-Word Task (Golden, 1978) were recorded for each participant as described in the methodology chapter. The mean reaction time for the interference condition for non-referred participants was calculated as a comparison (M = -191.06, SD = -97.22). Percentage correct for both normal and interference trials were recorded as well. AD/HD and non-referred participant data was compared to the mean to ensure the manipulation was successful. If the mean of either group fell within the standard deviation of the dummy mean, the percentage of normal and interfere that were correct were checked to ensure that faster times were not the result of quick reactions at the expense of accuracy. Most AD/HD participants fell outside of the average and standard deviation, those that did not had a percentage correct score below the dummy mean of 99%, ensuring that they were AD/HD and that they were unlikely to be under the influence of any stimulant medications.

Data Cleaning and Calculations

HR and calculating HR change. HR data was collected using the Biopac systems as outlined in the methodology chapter. Once HR data was collected, it was cleaned by examining heart rate for abnormalities (for example, a sudden decrease of over 20 beats per minute that may have been an error in collection and not an actual physiological response in the participant), and a resting heart rate (RHR) was calculated by averaging five seconds of HR during the two minute baseline period. The researcher made efforts to ensure the five seconds chosen for the average were representative of the baseline period HRs as a whole. Because the clips were in randomized order, the heart rate for each second for the first 30 seconds of each clip was taken and placed into the data file under the clip it was associated with (for example, all participants' HR data for the slow aversive clip about insects would be together regardless of what order they saw that clip in). Five-second averages were then calculated for each of these 30 second HRs, creating six five-second averages for each of the twenty-four clips for each of the participants. In order to understand trends in HR over time, HR change was calculated using the six five-second averages from each clip. Each five-second average was subtracted from the RHR obtained during data cleaning and compiling, yielding a rate of change from the RHR. For each clip there were six HR change values, one for each five-second average for the first 30 seconds of the clip.

Counting SCRs. For the purposes of this study, EDA was characterized by the number of SCRs that occurred during each of the video clips. SCRs were calculated using Acqknowledge 4.1.1 software, and an SCR was characterized by a cyclical change in EDA that was .02 μS or more from previous EDA. The number of SCRs for each video clip for each participant were counted according to these criteria and associated with the corresponding video clip in the data file like with the HR data.

Calculating d'. Before analyzing the rest of the data, the signal detection test responses were calculated for d'. Because hits, misses, false alarms, and correct rejections are interconnected, d' is a measure of the likelihood that with random guessing the participant would have had the number of hits and false alarms that they did. It is a better indicator of the confidence the participant had in the responses they were giving. Higher scores indicate more confidence as well as more accuracy on the signal detection tests. Hit rates were calculated by dividing the number of hits (correct identification of an image) by 24 (the total number of images where "hit" was the correct response). False alarm rates were calculated in the same manner, dividing the number of false alarms (claiming to see an image that was not present) by 24. For audio d', 12 was the number used to divide the responses by to get the hit and false alarm rates. To calculate d', the probability of the false alarm rate for each participant was subtracted from the probability of the hit rate, yielding a total of four d' values for each participant, one each for the first visual signal detection test and audio signal detection test and the second visual signal detection test and audio signal detection test.

Valence Effects

Several hypotheses dealt with the effects of valence on physiological responses and recall. Two levels of valence were manipulated in this study, aversive and appetitive, and clips were chosen based on the pilot study as outlined in the methodology.

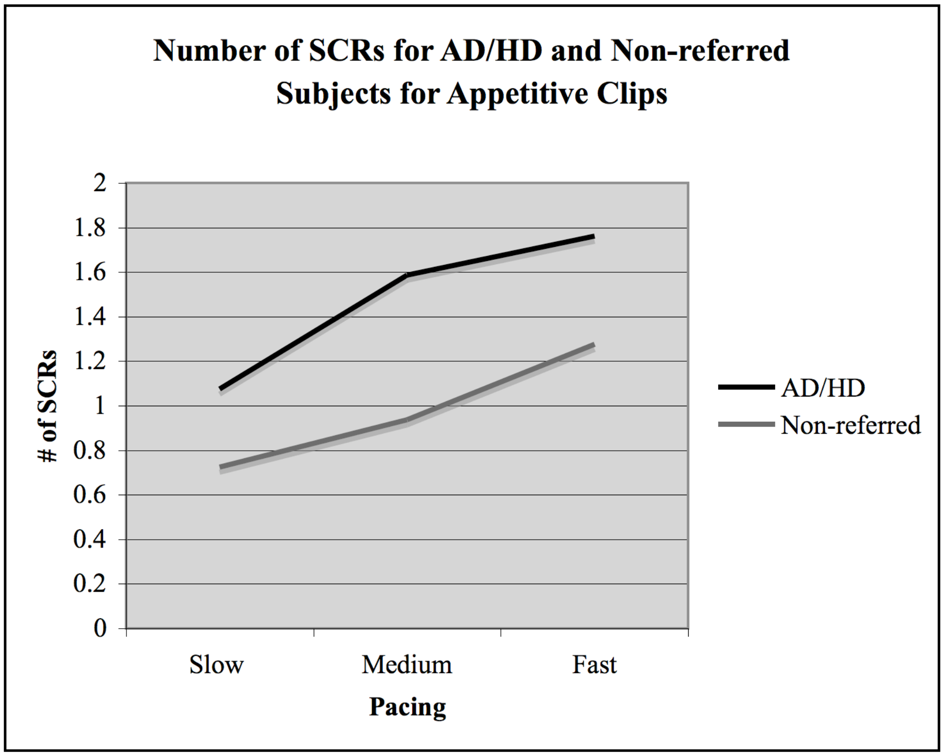
Effects on physiological responses. H_{2a} predicted that HR for appetitive clips would be lower than aversive clips across diagnostic condition. In order to test H_{2a}, a one-way repeated measures ANOVA was conducted to compare HR change as a result of valence. As predicted, a significant main effect of valence on HR was found, $F(1, 38) = 6.024$, $p < .05$, $\eta^2 = .137$. The effect was in the predicted direction, with HRs for aversive clips ($M = 2.201$, $SD = .587$) being higher than for appetitive clips ($M = 1.720$, $SD = 6.02$).

H_{2b} expanded on H_{2a} by predicting that AD/HD participants would have lower heart rates for appetitive clips than non-referred participants. Although there were no significant findings, HR for appetitive clips did trend in the predicted direction, with AD/HD participants having much lower HR on appetitive clips than the non-referred participants regardless of pacing.

H_{3a} predicted that the number of SCRs for appetitive clips would be lower than for aversive clips. A significant main effect was found for valence on the number of SCRs for all participants, $F(1, 38) = 35.637$, $p < .001$, $\eta^2 = .484$. The effect was in the predicted direction, with a higher number of SCRs for aversive clips ($M = 1.612$, $SD = .144$) than appetitive clips ($M = 1.227$, $SD = .137$).

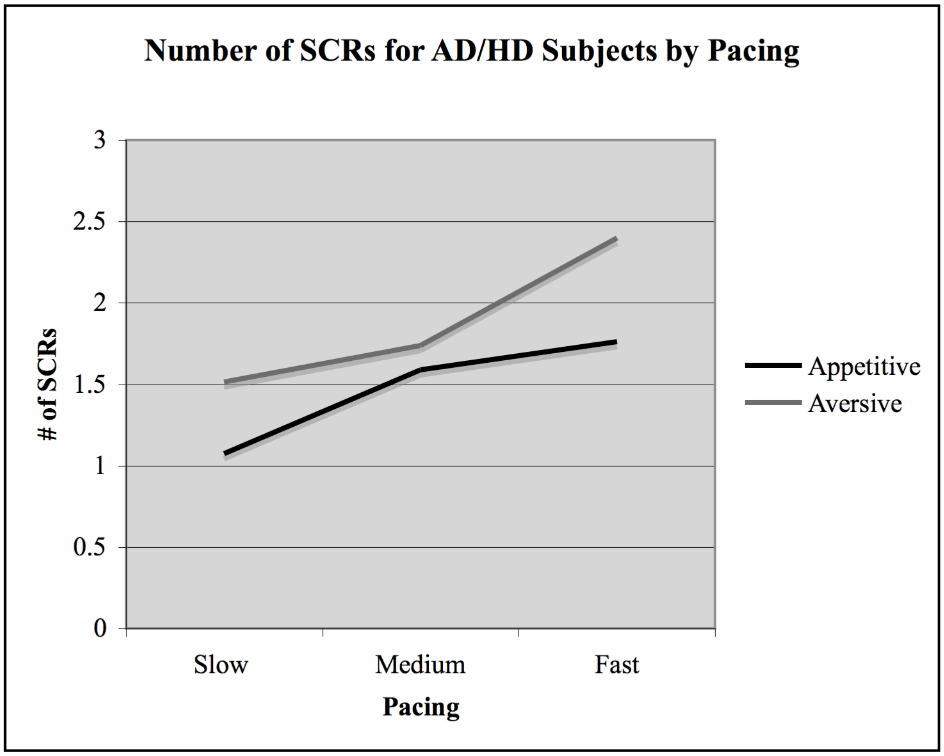
H_{3b} expanded on H_{3a} by predicting AD/HD participants would have lower numbers of SCRs than non-referred participants on appetitive clips. The number of SCRs for each clip was averaged and collapsed into a variable based on pacing and valence, resulting in six new variables. Independent samples t-tests were used to compare the means between the AD/HD and non-referred participants. None of the effects were in the predicted direction between the two groups, although within the two groups they were. Figure 6.1 illustrates this trend.

Figure 6.1.



As indicated in Figure 6.1, AD/HD participants had a higher number of SCRs for appetitive clips than the non-referred participants regardless of pacing. Figure 6.2 (p. 83) shows that within the AD/HD group, aversive and appetitive clip SCR means were as predicted, with appetitive clips having a lower incidence of SCRs than aversive clips.

Figure 6.2.



Effects on recall. H_{4a} predicted that recall for appetitive clips would be lower than for aversive clips. A paired sample t-test comparing the mean d' for appetitive and aversive clips found a significant difference between appetitive d' (M = 1.7601, SD = .49833) and aversive d' (M = 2.5825, SD = .51630) in the predicted direction, $t(39) = 22.338$, $p < .05$ (two tailed). The mean difference was -.82239 with a 95% confidence interval ranging from -1.00372 to -.64107. The η^2 statistic (.016) indicated a small effect size.

H_{4b} expanded on H_{4a} by predicting that AD/HD participants would have lower recall on appetitive clips than non-referred participants. This hypothesis was not supported as the mean d' for AD/HD participants on the appetitive clips (M = 1.7326, SD = .49655) was only slightly lower than the mean d' for the non-referred participants (M = 1.7875, SD = .51146). This trend was not significant, $t(38) = .345$, $p = .732$ (two tailed).

Pacing Effects

Several of the hypotheses predicted the effects of pacing on physiological responses and recall. Three levels of pacing were manipulated for this study: slow, medium, and fast. Pacing was determined by the criteria discussed in the methodology chapter.

Effects on physiological responses. H_{5a} and H_{5b} discussed effects on HR change as a result of pacing. H_{5a} predicted that HR would increase as pacing increased for all participants until the point of cognitive overload. Cognitive overload would be indicated by a sudden decrease in HR as a result of a lack of resources dedicated to an over-stimulating environment. A one-way repeated measures ANOVA compared heart rate across the three levels of pacing (slow, medium, and fast) and found a significant main effect for pacing on HR change, $F(1, 37) = 7.814$, $p < .01$, $\eta^2 = .297$. The descriptive statistics for each level of pacing are listed in Table 6.3.

Table 6.3
Descriptive Statistics for Change in HR as a Result of Pacing

	N	Mean	SD
Slow	40	1.857	.575
Medium	40	2.409	.607
Fast	40	1.616	.618

As predicted, an increase in pacing resulted in an increase in HR for slow and medium paced clips. For fast paced clips, however, HR was below that of the slow paced clips. This decrease could be explained by cognitive overload in the participants.

H_{5b} predicted that non-referred participants would reach cognitive overload more quickly than AD/HD participants. A one-way repeated measures ANOVA with a between-group comparison indicated that there were no significant interaction effects between diagnostic condition and pacing. An examination of the means between the two groups indicated that the effect was in fact in the opposite direction as predicted, with much higher HR change in the non-referred participants for fast paced aversive and fast paced appetitive clips.

H_6 predicted that as pacing increased, the number of SCRs would increase until the point of cognitive overload. A one-way repeated measures ANOVA indicated a significant main effect of pacing on the number of SCRs, $F(1, 37) = 35.601$, $p < .001$, $\eta^2 = .658$.

Table 6.4
Descriptive Statistics for Number of SCRs as a Result of Pacing

	N	Mean	SD
Slow	40	1.125	.130
Medium	40	1.350	.134
Fast	40	1.784	.169

As predicted, an increase in pacing resulted in an increase in the number of SCRs for all levels of pacing.

Effects on recall. H_7 predicted that non-referred participants would reach cognitive overload more quickly, resulting in lower d' on fast paced aversive clips. This was not supported by an independent samples t-test of the mean d' for fast paced aversive clips, $t(38) = .001$, $p = .999$ (two tailed). In fact, the two means were nearly identical between AD/HD ($M = 2.1853$, $SD = .84361$) and non-referred ($M = 2.1856$, $SD = .83814$) participants. Figures 6.7, 6.8, 6.9 and 6.10 (pp. 95-96) show trends in valence and pacing based on glucose condition.

Glucose Effects

Of particular interest in this study was the impact of glucose on physiological on signal detection test performance. Several hypotheses and research questions dealt with glucose effects.

Effects on physiological responses. RQ_3 and RQ_4 were concerned with physiological changes after the glucose was given to the participants. The patterns that emerged for SCR responses after the glucose was in the participants' system are illustrated below.

Figure 6.3

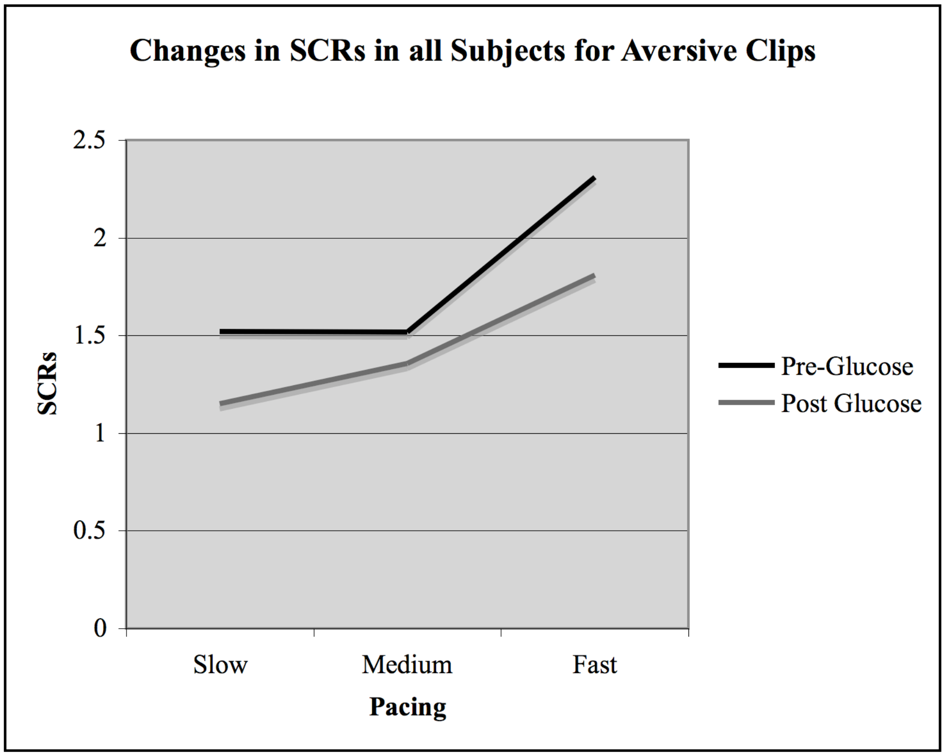
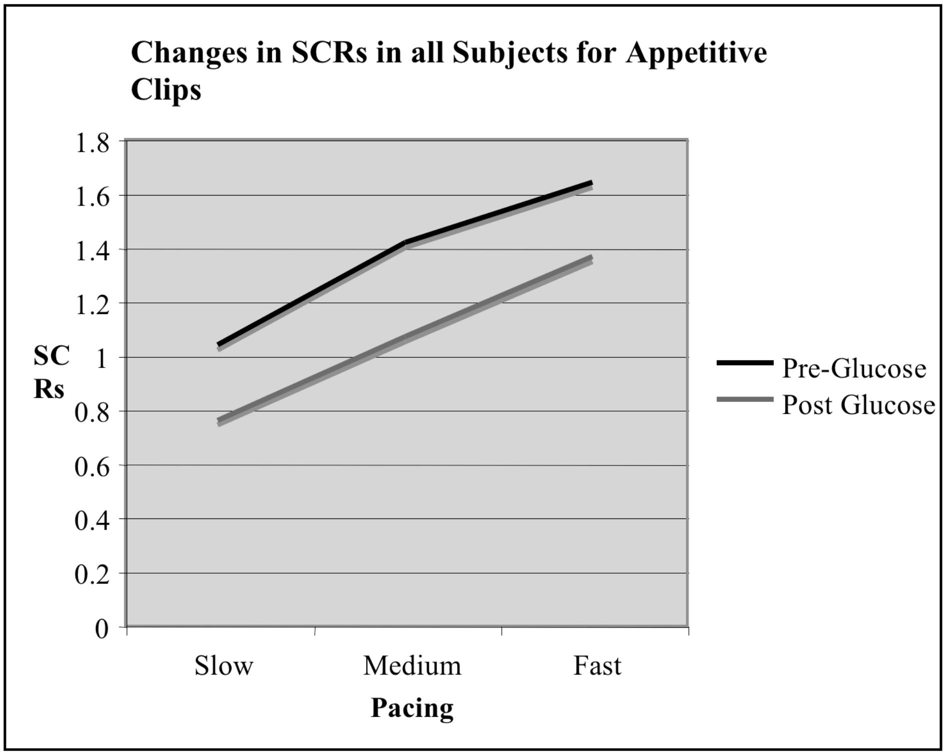


Figure 6.4



These changes were not significant, however it does appear that after the glucose there were fewer SCRs across diagnostic condition. What is interesting in Figure 6.3 is that there are virtually no changes in SCRs between slow and medium paced clips before the glucose, while there is more of a gradual increase between the two after the glucose.

For HR change, there was a dramatic increase in HR from the baseline after the glucose. In AD/HD participants, for example, nearly all HR change before the glucose was negative, meaning that the HR hovered near the RHR value. After the glucose, HR increased around 2 to 3 BPM for all clips. Table 6.4 (p. 88) lists the means pre and post glucose for both groups.

Table 6.4
Pre- and Post Glucose HR change in AD/HD and Non-referred participants

	Pre-Glucose AD/HD	Post Glucose AD/HD	Pre-Glucose Non-referred	Post Glucose Non-referred
Aversive				
Slow	-.28395	3.3204	.7430	4.7248
Medium	-.28395	2.5727	1.2113	5.7661
Fast	-0.1280	3.1309	1.6216	5.2777
Appetitive				
Slow	-.2878	3.0904	.3748	4.7222
Medium	-1.3075	3.0720	1.9549	5.6312
Fast	.2169	1.3039	.4676	1.8906

Effects on recall.

A paired samples t-test of d' for both visual signal detection and audio signal detection tests was conducted for all participants to evaluate the impact of the increased glucose. As predicted by H_8, d' increased significantly from the first set of signal detection tests to the second tests.

For the visual signal detection tests, d' for Video Signal Detection Test 1 (M = 1.672, SD = .547) was significantly lower than d' for Video Signal Detection Test 2 (M = 1.966, SD = .568), $t(39) = -2.746$, $p < .01$ (two-tailed). The mean decrease in d' was -.29 with a 95% confidence interval ranging from -.509 to -.077. The η^2 statistic (.16) indicated a large effect.

For the audio signal detection tests, d' for Audio Signal Detection Test 1 (M = 1.201, SD = .397) was significantly lower than for Audio Signal Detection Test 2 (M = 1.534, SD = .457), $t(39) = -.3021$, $p<.005$ (two-tailed). The mean decrease in d' was -.33 with a 95% confidence interval ranging from -.56 and -.11. The η^2 statistic (.19) indicated a large effect.

RQ_5 asked whether post-glucose recall in diagnosed participants would be comparable to pre-glucose recall in non-referred participants. A paired-samples t-test was run for each group separately to ensure that the trend confirmed by H_8 was true regardless of diagnostic condition. In the case of the non-referred participants, however, it was not a significant trend. For the non-referred participants, d' for Video Signal Detection Test 1 (M = 1.749, SD = .509) was not significantly lower than for Video Signal Detection Test 2 (M = 1.837, SD = .560), $t(19) = -.549$, $p = .589$ (two tailed). The same was true for audio and d' for Audio Signal Detection Test 1 (M = 1.212, SD = .535) was not significantly lower than for Audio Signal Detection Test 2 (M = 1.39, SD = .362), $t(19) = -1.107$, $p = .282$ (two tailed).

For the AD/HD participants the differences before and after the glucose were more revealing. In a paired samples t-test, d' for Video Signal Detection Test 1 (M = 1.595, SD = .585) was significantly lower than for Video Signal Detection Test 2 (M = 2.094, SD = .561), $t(19) = -3.849$, $p<.005$ (two tailed). The mean decrease in d' was -.49 with a 95% confidence interval ranging from -.77 and -.23. The η^2 statistic (.53) indicated a large effect. The same was true for the audio tests, where d' for Audio Signal Detection Test 1 (M = 1.19, SD = .185) was significantly lower than for Audio Signal Detection Test 2 (M = 1.67, SD = .362), $t(19) = -3.328$, $p<.005$ (two tailed). The mean decrease in d' was -.48 with a 95% confidence interval ranging from -.80 to -.18. The η^2 statistic (.37) indicated a large effect.

An independent samples t-test indicated there were no significant differences between the two groups for any of the trials, including the first trials of both signal detection tests. However, Figure 6.5 and Figure 6.6 (p. 90) illustrate an interesting trend in the d' values from before and after the glucose for each group.

Figure 6.5

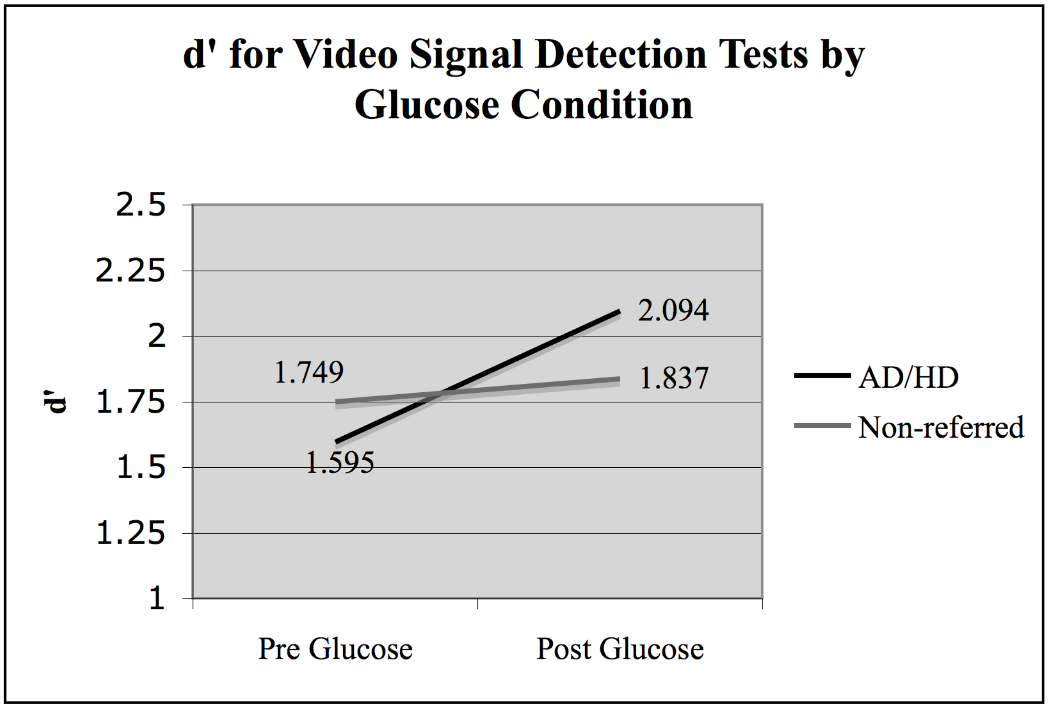
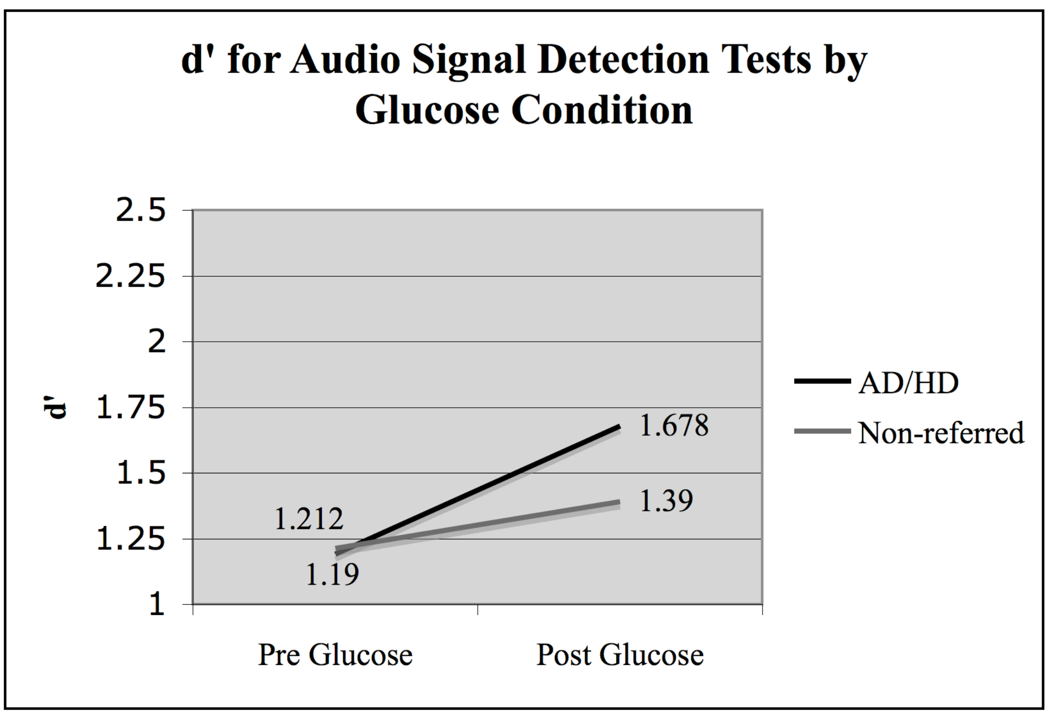


Figure 6.6



While non-referred participants have a modest and insignificant increase in d' from the first and second sets of test, AD/HD participants had a lower d' than the non-referred on the first set of tests and greatly surpassed the non-referred participants on the second set of tests. In response to RQ_5, it would appear that glucose has great potential for increasing the recall of individuals with AD/HD beyond the improvement seen in non-referred individuals.

Examination of the valence and pacing interactions with the glucose condition showed interesting trends illustrated in Figures 6.7, 6.8, 6.9, and 6.10 (pp. 95-96). Glucose appeared to improve AD/HD participants' recall on appetitive clips, leading to better performance than the non-referred group on slow paced and fast paced clips. In aversive clips, AD/HD participants had better performance on aversive clips than non-referred on all pacing conditions. However, after the glucose, non-referred performed better than AD/HD on fast paced aversive clips.

Differences in Diagnostic Conditions

Differences in recall. Besides the differences in recall discussed earlier in this section, H_1 predicted that the lack of impulse control associated with the disorder in other studies would result in a higher rate of false alarms from AD/HD participants. In order to test H_1, an independent samples t-test compared the diagnosed and non-referred participants on their overall hits and false alarms. Correct rejections and misses were excluded from the analysis because the four scores are interdependent, so a change in hits reflects a change in misses and a change in false alarms reflects a change in correct rejections. The independent samples t-test indicated that there was no significant difference between the diagnoses in terms of responses. Only one measure, the first audio signal detection test false alarms, was in the correct direction.

Differences in physiological responses. In response to RQ_1, differences in physiological measures were explored. An independent samples t-test of HR change based on valence and pacing found no significant differences in HR change between the two diagnostic conditions. Although there were no significant findings, there was a trend in means that indicated AD/HD participants having lower HR change than non-referred participants on all clips regardless of pacing or valence.

A significant difference in SCRs between the two groups was found. For medium paced aversive clips, AD/HD participants (M = 1.7375, SD = 1.02429) had significantly more SCRs than non-referred participants (M = 1.1375, SD = .74989), $t(38) = -1.128$, $p < .05$ (two tailed). For medium paced appetitive clips, AD/HD participants (M = 1.5875, SD = 1.06461) again had significantly more SCRs than non-referred participants (M = .9375, SD = .65331), $t(38) = -2.327$, $p < .05$ (two tailed). This trend was found for all other pacing and valence combinations, with AD/HD participants having a higher rate of SCRs than the non-referred participants, although these differences were not significant.

In response to RQ_4, no significant differences were found between AD/HD and non-referred participants in SAM responses. It is unlikely, then, that AD/HD results in a difference in perception of enjoyment, excitement, or control.

Overall, the significant differences between the two groups can be seen in the d' means for video and audio signal detection and in the d' means between clips of differing valence and pacing.

Summary

This series of studies has uncovered some interesting information regarding AD/HD prevalence and prevalence of attentional issues in the undiagnosed population, and the effects of pacing, valence, and glucose on the physiological responses of AD/HD and non-referred participants.

The survey data indicated that prevalence rates may be higher than previously assumed in the college population. It also noted that approximately 10% of the surveyed college student population may in fact be undiagnosed AD/HD.

Several hypotheses and research questions were asked about the data from the experimental portion of this dissertation. These hypotheses and research questions and their outcomes are listed in Table 6.5.

Table 6.5
Hypotheses and Research Questions and Their Findings

Hypothesis/ Research Question	Variables	Supported?
H_1	False alarm rate by diagnostic condition	No; incorrect direction
H_{2a}	HR change by valence (main effect)	Yes; $p < .05$; $\eta^2 = .137$
H_{2b}	HR change by valence (diagnostic interaction)	Partially; insignificant
H_{3a}	SCR frequency by valence (main effect)	Yes; $p < .001$; $\eta^2 = .484$
H_{3b}	SCR frequency by valence (diagnostic interaction)	No; incorrect direction
H_{4a}	d’ by valence (main effect)	Yes; p < .05; $\eta^2 = .016$
H_{4b}	d’ by valence (diagnostic interaction)	No; insignificant
H_{5a}	HR change by pacing (main effect)	Yes; $p < .01$; $\eta^2 = .297$
H_{5b}	HR change by pacing (diagnostic interaction)	No; incorrect direction
H_6	SCR frequency by pacing	Yes; $p < .001$; $\eta^2 = .658$
H_7	d’ for fast paced aversive clips by diagnosis	No; no significance
H_8	d’ by glucose condition	Yes; $p < .01$; $\eta^2 = .16$
RQ_1	Physiological differences by diagnosis	Yes; insignificant
RQ_2	SAM ratings by diagnosis	No difference.
RQ_3	HR changes by glucose condition	Yes
RQ_4	SCR frequency by glucose condition	Yes
RQ_5	d’ of diagnostic groups by glucose condition	Yes for AD/HD

This study revealed several interesting trends in how pacing, valence, and glucose can affect performance of AD/HD and non-referred individuals on post-tests. As predicted, valence and pacing each had a significant effect on HR and the frequency of SCRs (see H_{2a}, H_{3a}, H_{4a}, H_{5a}, and H_6 in Table 6.5). For SCRs, an increase in pacing was directly related to an increase in the frequency of SCRs regardless of diagnostic condition. For HR, increase in pacing was directly related to increase in HR. For aversive, fast paced clips however, HR decreased, indicating cognitive overload.

The most interesting finding is the significant improvement of performance on signal detection tests by AD/HD participants (see RQ_5 in Table 6.5). While non-referred participants had modest improvements between the pre-glucose and post-glucose trial, AD/HD participants surpassed the non-referred performs and made significant gains in d' between the two trials.

There were few significant differences in physiological or self-report data found as a result of diagnostic condition (see H_{3b}, H_{4b}, H_{5b}, and RQ_2 in Table 6.5). Two differences, changes in HR as a result of valence and HR change between the two diagnostic groups, were in the predicted direction but were not significant (see H_{2b}, RQ_1, and RQ_5 in Table 6.5).

Figure 6.7

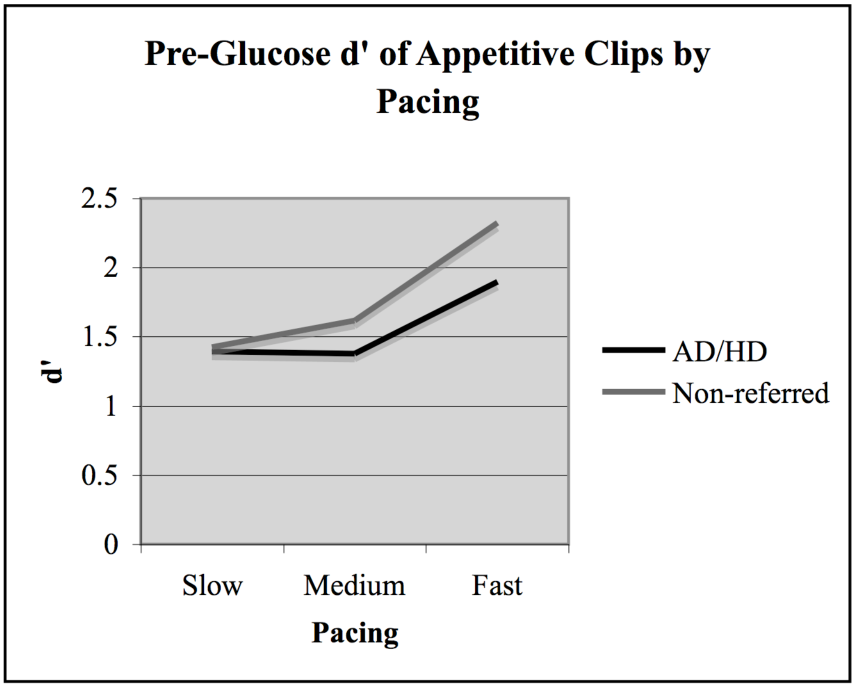


Figure 6.8

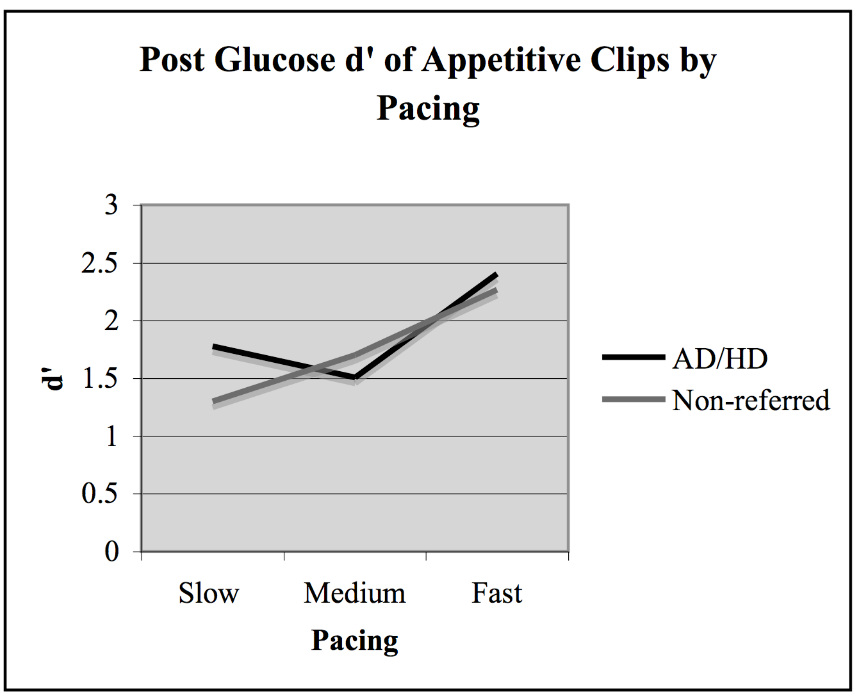


Figure 6.9

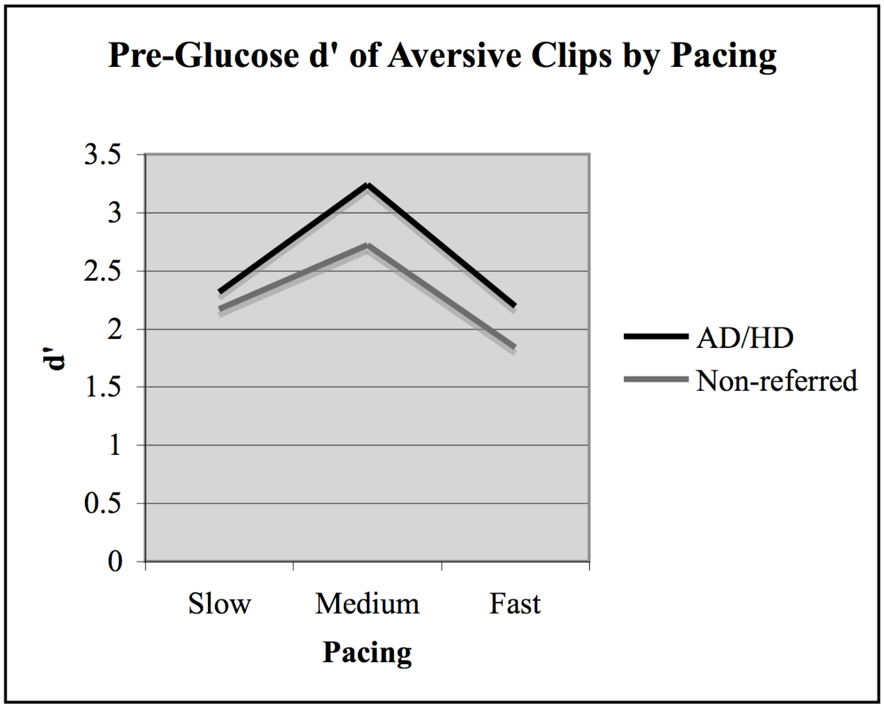
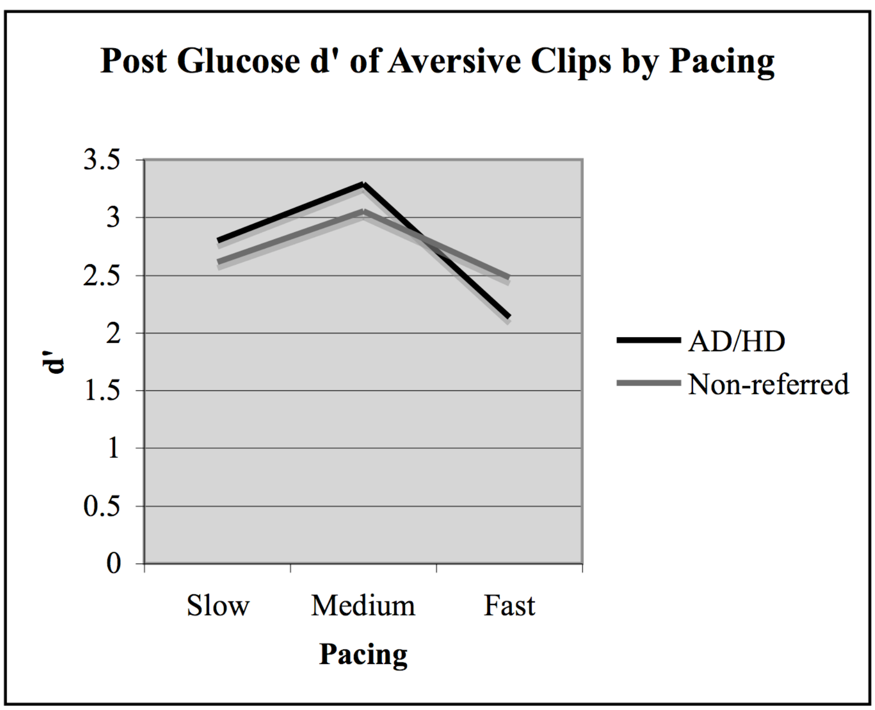


Figure 6.10



CHAPTER 7

DISCUSSION

This study sought to examine the relationship between an attention disorder, attention theories, and self-regulation theories and how these relationships may be used as a model for future educational videos or games. What it found both through the screening survey and psychophysiological experiment contributes to the body of knowledge about the disorder.

Although prevalence rates at their highest are estimated at 10% for children (Rowland, et al.., 2002) and 4.4% for adults (Kessler, et al.., 2006), nearly 18% of the sample had been diagnosed with AD/HD at some point in their life. This could indicate that prevalence rates are much higher than previously assumed, or that since 2006 the quality of diagnosis has risen. It is also possible that, due to their academic difficulties, more AD/HD individuals were taking advantage of the extra credit opportunity that completing the online survey gave them, inflating the overall percentage of AD/HD diagnosed survey participants.

Looking at the percentage of non-referred participants that fell into the “low” category can be misleading because several answered “Not at all” to all of the scale items, making it highly likely that these participants were trying to complete the survey quickly simply to earn credit. The general population could easily answer “Moderately” or “Quite a lot” to a few of the items on the screening survey (see Appendix A). As discussed earlier, the literature has noted that females are less likely to be diagnosed because of a difference in manifestation of the disorder (Barkley, 2003) and this was reflected in the distribution of score ranges, where 12% of females fell into the “High likelihood” category versus 7% of males.

It is important to note that high scores on the screening exam are not a diagnosis, only an indicator that there may be an attention disorder in that individual. A full diagnostic screening would be required to determine whether or not these individuals did have AD/HD or another similar attention disorder. These scores combined with a relatively low level of knowledge about the disorder that was self-reported by the survey respondents may indicate that there are many individuals who have lived into their 20s with the disorder and without any knowledge that they have it. Depending on how severe the disorder is, undiagnosed individuals may be suffering poor academic and career performance, financial issues, relationship problems, and other impacts of the disorder.

The survey was not a comprehensive questionnaire about awareness, risk factors, or attitudes toward AD/HD and so there is not much more that can be discussed in terms of the survey. The few responses that were obtained seem to indicate there should be more awareness about the disorder to encourage acceptance and to ensure that those suffering with the disorder do not have to face the challenges associated with AD/HD without assistance.

In the experimental portion of this dissertation, main effects of valence and pacing on HR, SCRs and recall were significant in the predicted directions. As predicted, as pacing increased, HR and frequency of SCRs increased and highest HR and SCRs were observed during aversive clips. Because executive functioning is often inefficient in those with AD/HD (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005), these main effects confirm that cognitive processes when viewing mediated messages work much the same way as in non-referred participants that are traditionally studied in LC4MP. This finding was important in establishing that empirically supported hypotheses about mediated messages and cognition are applicable to

AD/HD participants and not just their non-referred counterparts. Had this not been the case, the trends noted in other portions of the study would not be as reliable.

The literature has noted that AD/HD children greatly prefer watching television over other activities and more than their non-referred cohort (Acevedo-Polakivich, Lorch & Milich, 2007), and the HR data from the experiment seems to confirm the theory that television has a soothing effect on the symptoms of the disorder. Before the glucose, nearly all HR change in AD/HD participants was negative, meaning that it was higher than the baseline or RHR that was obtained before the videos began. After the glucose the HR of the AD/HD participants was lower. While a similar phenomenon was noted in the non-referred participants, this soothing in AD/HD participants resulted in a drastic improvement in recall. It is also interesting to note that there were no significant differences in SAM ratings between the two groups.

Physiological data revealed some differences in responses to media viewing between AD/HD and non-referred groups. Beyond the HR discussed before, AD/HD participants experienced more frequent SCRs and performed significantly better than the non-referred participants on both signal detection tests after they had been given glucose. Although there were differences in physiological responses between diagnostic groups, these were not significant.

As a context for this study, the parameters of LC4MP were tested using a population with a known attention disorder. Because that theory focuses heavily on attention and how it impacts resource allocation (Lang, 2000), testing it with a population that has known deficiencies in both was important to determine if large disparities exist. According to LC4MP, the primitive brain responds to video stimuli much in the same way it would natural threats or benefits. A lack of attention to stimuli, then, should result in a different pattern of physiological responses typically observed in non-referred subjects. As evidenced by the data, this was not the case. The lack of differences in physiological responses between the two conditions, then, is an interesting finding. When coupled with the vast improvement in recall after the glucose for the AD/HD participants without any significant changes in physiological responses, it requires further examination. One potential explanation for this finding is the executive dysfunction that has been noted in the literature (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). While the brain may have enough resources to recognize a "threat" and initiate physiological responses to these stimuli, it may not conserve enough resources to encode and store the information for later recall. When more resources (the glucose) were made available, more were available after physiological responses were initiated, resulting in improved storage and recall.

As suggested by self-regulation theory, increasing glucose available to the brain increased the limited resources it uses for processing messages. While some improvement can be expected from familiarity with the signal detection test procedures, the large effect sizes seen in d' improvement between the AD/HD participants' first and second trials indicate that glucose availability had a significant impact on performance. This was expected as earlier research has indicated that glucose processing is an effect of the stimulant medication most often used to treat AD/HD (Solanto, Arnsten, & Castellanos, 2001) and other stimulants that have been used to treat AD/HD symptoms in other experiments (e.g. nicotine, Conners, et al., 1996). The findings suggest that glucose combined with some form of increase in HR and metabolism (in this study, pacing) may simulate stimulant medication for a short period of time.

Resources required and resources allocated are optimal for medium paced clips according to the literature (Lang, et al., 2000). As a result, d' should be highest for medium aversive clips, which was the case for both groups. Slow paced clips require a lower amount of resource allocation and so encoding suffers from a lack of resources and focused attention. Improved encoding on the slow paced clips by both groups suggests that more resources are allocated when more are available. This seems to suggest that providing AD/HD and non-referred students with more raw materials (i.e. glucose) could improve their performance in classes and situations that they generally consider boring by providing their brain with more resources to allocate to low-level stimuli.

Glucose, then, serves two purposes. It can improve attention in the sense of rapid allocations of resources to stimuli in the case of slow paced, "boring" stimuli. It can also improve the product of attention—storage—by providing the brain with more resources for cognitive processes. This glucose compensates for deficiencies in executive functioning by providing it with more resources to work with.

In comparing Figures 6.7-6.10, the d' of AD/HD and non-referred participants may be indicative of the effects of the glucose on cognitive resources. AD/HD participants showed an improvement on nearly all measures after the glucose except for fast paced, aversive clips. The literature notes that fast paced aversive clips are the most stimulating in terms of resource allocation, and the most likely to result in cognitive overload (Lang, Bolls, Potter, & Kawahara, 1999). Glucose may stimulate AD/HD information processing so much that while it improves encoding for other conditions, fast paced aversive clips are too stimulating, resulting in cognitive overload before the non-referred participants.

While it was predicted that AD/HD participants would have a higher rate of false alarms due to their lack of impulse control, this was not the case according to the data. It may be that most participants took stimulant medication regularly and were not confident in their responses and so they erred on the side of caution by reporting that they had not seen signals that were present. False alarms may not result from lack of impulse control and thus were not a good indicator of that attribute in AD/HD.

From a practical standpoint, these findings have indicated a new area for examination for those with AD/HD. While a constant stream of glucose is not a feasible option for long-term health, incorporating glucose with more stimulating learning experiences could result in better recall of information from those experiences. For brief periods of time this is a completely acceptable solution. By giving an AD/HD student glucose and exposing them to a message, more resources will be available to improve the storage of that information, making it more likely they will be able to recall it at a later time.

Based on the findings of this study, medium paced, highly aversive video clips (or possibly video games) combined with a quickly digestible snack could ultimately result in improved academic performance and increased attention to relatively short "boring" tasks. A candy bar before class, for example, could improve attention to lectures, which would result in more thorough notes and better independent recall after the class was completed. A glass of orange juice while studying those notes could improve recall even more. Ultimately these short term uses of glucose in place of a stimulant could result in improved performance on exams and other assessments, resulting in better grades and more confidence in academic endeavors.

Limitations

Several limitations should be noted in the studies discussed in this dissertation. While it is unlikely that the majority of these limitations had a significant impact on the data presented here, it is possible that addressing them in future research can only serve to improve the quality of research on what could prove to be an important line of research for AD/HD participants.

As evidenced by the scores displayed in the table, evaluations for those clips considered highly aversive were much more polarized than those considered highly appetitive by raters. For example, the clip with the most aversive scores (*M* = 1.28) was only a third of a rating point above the lowest possible score, whereas the clip with the most appetitive score (*M* = 6.04) was almost an entire rating point below the highest possible score. This is possibly a result of the sexual nature of many of the appetitive clips, which may have made some of the more conservative raters less interested or less likely to self-report interested in the clips. It is also just as possible that the relatively "tame" nature of the appetitive clips (particularly the sexual ones) resulted in the lower scores. This is even more likely as the highest scoring clips featured other, less sexual appetitive visuals like puppies, children, and suggestions of wealth.

In discussing the results of the experimental study, many values were approaching significance. This is likely due to the low number of participants (N = 40) that participated in the experimental portion of the study. For psychophysiological research a low N is not necessarily an issue as most data analysis will be within-participants comparisons. For this research, however, comparisons between groups demanded at least 20 of each diagnostic condition, which was obtained for this study. Every effort was made to recruit more participants, and over 100 individuals were contacted about this study, but the hour-long study time and the drug holiday requirement made it difficult for many of those contacted to participate. Another trial of this study with a larger number of participants may reveal some more subtle trends in physiological responses that were not found here.

Although the screening exam was used to weed out participants that may not have had AD/HD and those who had been diagnosed, there was no practical way to ensure that those with lower scores did not have AD/HD. Because AD/HD is a disorder that can manifest itself differently based on a variety of variables, such as age and gender, it is possible that one or more of the participants did actually have the disorder. Along the same lines, it was impractical to determine or test for the subtype of AD/HD that each AD/HD participant had. Because subtypes do have some distinct differences, an examination of these subtypes and their interaction with glucose and recall would be an important next step in future research on this topic.

Conclusion

There is still a great deal of information about AD/HD, video pacing, and self-regulation that is unknown. Are educational videos a viable option for the marked improvement of education and career success? The results from this experiment seem to suggest it has a great deal of potential. While it does seem promising, this study did not address long-term retention of knowledge, which is another aspect of video pacing and glucose administration that would need further research.

There are still many aspects of AD/HD's impact on the lives of sufferers that have not been addressed in studies. Although AD/HD is becoming more accepted as a legitimate disorder with legitimate impact on the lives of those with it, it is still necessary to examine many aspects of the disorder both in terms of societal knowledge and when seeking out ways to supplement traditional education. Ultimately it is hoped that this study can pave the way for a more productive outlook on media and its potential to help and not hurt those who have diagnosed attention disorders. Media have often been under attack for their impact on society, and this study, and others like it, are necessary to show that media is only a tool with great potential.

This study focused on attention and its by-product, recall. This is only one small part of the disorder that disrupts the lives of those with AD/HD. Although it is a single component, addressing the issue of attention is an important step in improving the lives of students and workers with AD/HD who often struggle for academic success. By providing an alternative to stimulant medication, this study has indicated that glucose, especially when combined with medium paced, aversive video, can improve recall for those with AD/HD.

Further research on videos and long-term impact on memory and recall is necessary before a solid conclusion can be reached about the potential for media as a tool for AD/HD management and learning, but this study has laid the groundwork by examining the effects of pacing combined with glucose. It is nice to think of a future where a college student can eat a candy bar, play a game or watch a video on their phone, and then go to class and actually improve their academic performance. While this study alone cannot make that a reality, it is hopefully a sign of the possibilities to come.

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APPENDIX

APPENDIX A

Jasper and Goldberg Adult AD/HD Screening Questionnaire

For each question, a response of "Not at all" (1), "Just a little" (2), "Somewhat" (3), "Moderately" (4), "Quite a lot" (5), or "Very much" (6) will be given. A total score of 70 or above indicates a likelihood that the survey taker has AD/HD.

1. Do you have a sense of underachievement, of not meeting your goals, regardless of how much you have actually accomplished?
2. I find it difficult to read written material unless it is very interesting or very easy.
3. Especially in groups, I find it hard to stay focused on what is being said in conversations.
4. I have a quick temper…a short fuse.
5. I am irritable, and get upset by minor annoyances.
6. I say things without thinking and later regret having said them.
7. I make quick decisions without thinking enough about their possible bad results.
8. My relationships with people are made difficult by my tendency to talk first and think later.
9. My moods have highs and lows.
10. I have trouble planning in what order to do a series of tasks or activities.
11. I easily become upset.
12. I seem to be thin skinned and many things upset me.
13. I am almost always on the go.
14. I am more comfortable when moving than when sitting still.
15. In conversations, I start to answer questions before the questions have been fully asked.
16. I usually work on more than one project at a time, and fail to finish many of them.
17. There is a lot of "static" or "chatter" in my head.
18. Even when sitting quietly, I am usually moving my hands or feet.
19. In group activities it is hard for me to wait my turn.
20. My mind gets so cluttered that it is hard for it to function.
21. My thoughts bounce around as if my mind is a pinball machine.
22. My brain feels as if it is a television channel with all the channels going at once.
23. I am unable to stop daydreaming.
24. I am distressed by the disorganized way my brain works.

APPENDIX B

Medications Inclusion List

Participants on multiple medications or on any unlisted medications were excluded from the study to ensure their health and safety and the integrity of the study itself. The following medications were included in the proposed study:

Adderall (6 hrs duration)
Adderall XR (12 hrs duration)
Concerta (12 hrs duration)
Daytrana (patch - 12 hrs duration)
Desoxyn (Methamphetamine) - (12 hrs duration)
Dexedrine (6 hrs duration)
Dexmethylphenidate (6-10 hrs duration)
Dextroamphetamine (4 hrs duration)
Dextroamphetamine/amphetamine (8-10 hrs duration)
Focalin (6 hrs duration)
Focalin XR (10 hrs duration)
Lisdexamfetamine (12 hrs duration)
Metadate CD (10 hrs duration)
Metadate ER (8 hrs duration)
Methamphetamine (12 hrs duration)
Methylin (4 hrs duration)
Methylin ER (8 hrs duration)
Methylphenidate (4 hrs duration)
ProCentra (5 hrs duration)
Ritalin (4 hrs duration)
Ritalin LA (10 hrs duration)
Ritalin SR (8 hrs duration)
Vyvanse (12 hrs duration)

APPENDIX C

Pacing of Selected Stimulus Clips

Aversive Clips

- **Slow (6 or fewer edits)**
  - *Kitchen Nightmares: Roaches in the Refrigerator (:31) (M = 1.63; SD = .35)*
  - *Rwanda Genocide (:40) (M = 1.28; SD = .15)*
  - *China Kidnapping (:36) (M = 2.26; SD = .44)*
  - *Haiti Aftermath (:41) (M = 1.46; SD = .39)*
- **Medium (9 to 11 edits)**
  - *Kitchen Nightmares: Rotten Food (:31) (M = 1.75; SD = .49)*
  - *Monsters Inside of Me: Botfly Maggots (:34) (M = 1.85; SD = .32)*
  - *Don't Text and Drive (:34) (M = 1.49; SD = .34)*
  - *Bridge Collapse (:38) (M = 2.33; SD = .87)*
- **Fast (14 or more edits)**
  - *Wear Your Seatbelt (:36) (M = 2.27; SD = .32)*
  - *Monsters Inside of Me: Maggots (:42) (M = 1.54; SD = .45)*
  - *Sudan Genocide (:30) (M = 1.87; SD = .31)*
  - *Tsunami (:45) (M = 2.77; SD = .71)*

Appetitive Clips

- **Slow (6 or fewer edits)**
  - *Cottonelle Puppy Tissue Test (:30) (M = 6.04; SD = .73)*
  - *Jenny Craig: Valerie Bertinelli (:30) (M = 5.36; SD = .56)*
  - *Carl's Jr.: Kim Kardashian (:) (M = 4.88; SD = .49)*
  - *State Farm: Cars (:30) (M = 5.21; SD = .62)*
- **Medium (9 to 11 edits)**
  - *Victoria's Secret Confessionals (:30) (M = 5.27; SD = .58)*
  - *Calvin Klein Envy (:30) (M = 5.19; SD = .72)*
  - *Carl's Jr.: Padma Lakshmi (:33) (M = 5.19; SD = .68)*
  - *Jenny Craig: Nicole Sullivan (:30) (M = 5.32; SD = .52)*
- **Fast (14 or more edits)**
  - *Cottonelle: Be Kind to Your Behind (:30) (M = 5.89; SD = .66)*
  - *Michael Bay's Victoria's Secret (:34) (M = 5.35; SD = .64)*
  - *State Farm: Cash (:30) (M = 5.38; SD = .53)*
  - *Tuscan Car Review (:41) (M = 5.19; SD = .62)*