The effects of stimulant medication on the social behavior of children with ADHD during times of play

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THE EFFECTS OF STIMULANT MEDICATION ON THE SOCIAL BEHAVIOR OF CHILDREN WITH ADHD DURING TIMES OF PLAY

A Dissertation
Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College
In partial fulfillment of the Requirements for the degree of Doctor of Philosophy

in

The Department of Psychology

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ABSTRACT

Psychomotor stimulants are the most commonly prescribed medications for the treatment of ADHD in children and adults. A vast literature has evolved concerning the efficacy and potential side effects of these drugs. Although stimulants are generally regarded as safe and effective, there is concern that potential problems may have been overlooked. Specifically, there is some literature indicating that, at least in some cases, stimulant medications may produce significant disruptions in social behavior. To investigate these effects, a number of different measurements were employed with preschool children, including direct observations during times of play, a social reinforcer assessment and a number rating scale/interview measures. The results indicate that three of the six participants displayed heightened levels of anxiety or stereotyped behaviors in specific settings while taking their prescribed dose of stimulant medication. The social reinforcer assessment revealed that the value of social reinforcers (i.e., playing with others) decreased for two of the participants while on their prescribed dose of medication. A corresponding increase in the value of nonsocial reinforcers (i.e., playing alone or quiet
time) was observed for both of these participants as well. Another participant displayed the opposite effects in the reinforcer assessment while taking stimulant medication. The value of social reinforcers appeared to increase for this participant while taking the prescribed dose of stimulant medication. The findings from the rating scales were inconclusive, and did not correspond well with the direct observations. The relevance of these findings from the direct and indirect measures as well as the reinforcer assessment will be discussed.

Key Words: Attention deficit hyperactivity disorder, behavioral pharmacology, play, social behavior, stimulant medication
CHAPTER 1: INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is the most commonly diagnosed childhood behavior disorder. Current consensus is that the disorder affects approximately 3 to 10% of school aged children (Murray & Patel, 2001). It has been estimated that three to six million children are currently receiving stimulant medication, with an upward trend in recent decades that is expected to continue (Murray & Patel, 2001; Safer, Zito & Fine, 1997). Approximately 90% of children receiving a diagnosis of ADHD are treated with stimulant medication at some point in their lives (Pelham, 1993). In addition, there is an increasing trend to prescribe stimulant medication to young children (i.e., ages 3 to 5) (Zito, Safer, dosReis, Gardner, Boles & Lynch, 2000). There is a vast literature concerning the efficacy and side effects of stimulant medications. The tenor of this literature is that stimulants are both effective and benign.

Overview of the Literature

Stimulants have been the most exhaustively researched medication in all of child psychiatry. Over the last several decades, the short-term efficacy of stimulants for the treatment of the core symptoms of ADHD (i.e., inattention, hyperactivity) has been well documented. The
literature indicates that 70% to 96% of children between the ages of 6 and 18 have a positive response for the treatment of the core symptoms of ADHD (Barkley, 1977a; Elia, Borcherding, Rapoport & Keysor, 1991). Controlled studies evaluating the effects of stimulants have demonstrated their effectiveness for decreasing the occurrence of interrupting class, reducing task-irrelevant activity in school, improving attention and compliance, increasing attentiveness during games of baseball, improving parent-child interactions, improving teacher-child interactions and decreasing the occurrence of overt and covert aggression (Barkley et al., 1985; Barkley, 1989; Jacobvitz, Sroufe, Stewart & Leffert, 1990; Pelham, Gnagy, Chronis, Burrows-MacLean, Fabiano, Onyango, Meichenbaum, Williams, Aronoff, Steiner, 1999; Schachter, Pham, King, Langford, Moher, 2001; Spencer, Biederman, Wilens, Harding, O'Donnell, Griffin, 1996; Swanson, McBurnett, Wigal, Pfiffner, Lerner, Williams, Christian, Tamm, Willcutt, Crowley, Clevenger, Khouzam, Woo, Crinella & Fisher, 1993; Tallmadge and Barkley, 1983; Whalen et al., 1980; Whalen et al., 1981).

Although the literature pertaining to the effects of stimulant medications on the core symptoms of ADHD is quite convincing, the efficacy of these drugs for the treatment
of ancillary features of ADHD is not as clear. Stimulants have not been shown to be effective for improving social skills nor have they shown any consistent benefit in academic performance (Carlson & Bunner, 1993; Gittleman-Klein & Klein, 1976; Rie, Rie, Stewart & Ambuel, 1976a; Rie, Rie, Stewart & Ambuel, 1976b).

Difficulties with peer relationships are extremely common in children diagnosed with ADHD. These children tend to engage in controlling behavior (i.e., being “bossy”), are more aggressive than same-age peers, and have fewer reciprocal social exchanges with peers (Landau & Milich, 1988). Reports of stimulant-induced decreases in aggression are common, yet few studies have demonstrated improvements in prosocial behavior. As will be discussed in more detail later, several studies have shown that stimulants have the potential to produce significant disruptions in social behavior (Schliefer, Weiss, Cohen, Elman, Cvejic & Kruger, 1975; Whalen, Henker, Collins, McAuliffe & Vaux, 1979).

Additionally, children diagnosed with ADHD frequently exhibit academic problems, including poor performance in math and reading. Although some studies have suggested that stimulant-induced improvements in attention span may improve scholastic achievement, there has been little evidence to indicate that stimulants produce any
significant improvements in direct measures of academic skills, such as information retention, acquisition of new skills or IQ scores (Gittleman-Klein & Klein, 1976; Rie et al., 1976a; Rie et al., 1976b; Swanson et al., 1993).

Although stimulants have been extensively studied in children aged 6 to 18, relatively few studies have specifically investigated their effects in children under six years of age. Since 1975, only nine double-blind placebo controlled medication evaluations using stimulants have been conducted with children in this age range (Connor, 2002). Of these nine studies, eight reported significant improvements for the core symptoms of ADHD while taking stimulant medication (Barkley, 1988; Barkley, Karlsson, Strzelecki, Murphy, 1984; Byrne, Bawden, DeWolfe, Beattie, 1998; Conners, 1975; Cunningham, Siegel & Crawford, 1985; Handen, Feldman, Lurier & Murray, 1999; Mayes, Crites, Bixler, Humphrey & Mattison, 1994; Monteiro-Musten, Firestone, Pisterman, Bennett & Mercer, 1997). Several of these studies documented specific improvements in behavioral domains, including hyperactivity and impulsivity (Conners, 1975; Mayes et al., 1994; Byrne et al., 1998) as well as improvements in interpersonal domains, including decreases in inappropriate social interaction and aggression (Barkley, et al., 1984; Barkley,
et al., 1988, Byrne, et al., 1998; Monteiro-Musten, et al., 1997). Schliefer and colleagues (1999) determined that the effects of stimulants are more variable in preschool children and did not show clear beneficial effects for most of the children (25 of 28 participants). Although not all studies regarding the effects of stimulants are in agreement, the literature indicates that stimulant medications are beneficial for the treatment of ADHD in preschool children.

Although the majority of these studies attest to the efficacy of stimulants in preschool children, side effects were not systematically evaluated in any these studies and several did not report side effects at all. Two studies have systematically evaluated side effects of stimulant medication in preschool children with ADHD (Barkley et al., 1985; Firestone, Monteiro-Musten, Pisterman, Mercer & Bennett, 1998). The findings from these studies indicate that side effects tend to be more common in young children and include irritability, nightmares, sleep disturbances and alterations in appetite. Although observed more frequently in young children, stimulant side effects are generally considered to be mild (Barkley, 1985; Connor, 2002; Firestone, 1998).
The Developmental Significance of Play

In spite of the prevailing attitude that stimulants, as used to treat ADHD, are very safe, there is a literature regarding their potential adverse effects on the social and play behaviors of children that appears to be widely overlooked. Basic research has consistently shown that drugs such as methylphenidate and amphetamine decrease social and play behavior in animals. Additionally, although less definitive, a number of clinical studies suggest that stimulants can produce significant disturbances in social behavior in humans as well.

This is potentially important because disruption of play and social behavior may have serious developmental consequences. A major component of wakeful behavior in higher mammals from the time of infancy to adulthood is social play. Play is thought to provide the first expression of many adult behaviors, including sexuality, aggressiveness, affiliative behavior and parental behavior (Pellis & Pellis, 1990; Poole & Fish, 1976; Taylor, 1980). In addition, play may have a significant role in the development of motor and sensory skills, language, and intelligence (Hofer, 1981).

Surprisingly, the empirical literature regarding the significance of play in children is sparse. Much of what is
known about the significance of play comes from basic research with animals. Social play in rats displays an inverted U-shaped function with respect to age; it emerges about 18 days after birth, peaks during the fourth and fifth week of life and then declines into adulthood (Meaney & Stewart, 1981; Thor & Holloway, 1984; Vanderschuren, Niesink & Van Ree, 1997). Researchers have found that the opportunity to engage in social play is particularly important for normal social development in the rat (Hol, Van den Berg, Van Ree & Spruijt, 1999, Van den Berg, Hol, Van Ree, Spruijt, Everts & Koolhas, 1999). Deprivation of play during the fourth week of life produces serious disruptions in normal sexual functioning and agonistic behavior, while deprivation during the fifth week of life does not appear to produce any significant differences in social development (Hol, et al., 1999). These findings indicate that there is a critical period in which social play may have a particularly important effect on development. Einon, Morgan and Kibbler (1978) found that rats deprived of social interaction for extended periods of time developed normally if allotted brief periods of play (i.e. 60 minutes each day), whereas socially isolated rats not allowed to play displayed abnormal social functioning. This finding suggests that the observed abnormal social
development is the result of play deprivation, rather than the deprivation of social contact per se.

A number of studies have investigated the effects of social deprivation on the subsequent social development of young non-human primates (Mason, 1963; Michael & Zumpe, 1998; Suomi, 1973; Suomi & Harlow, 1972). Socially deprived monkeys exhibit a number of abnormal social behaviors including decreased grooming and abnormal play behavior. Although no non-human primate studies have specifically investigated play, it is possible that deprivation of play during periods of social isolation contributes to abnormal social development.

The Effects of Stimulants on Play and Related Social Behavior – Basic Research

A number of studies have examined the effects of stimulants on play behavior in animals. Without exception, these studies show that stimulant drugs significantly decrease play behavior. Beatty, Dodge, Dodge, White and Panksepp (1982) investigated the effects of stimulant medications on a number of social behaviors in rats. Specifically, they evaluated the effects of methylphenidate (0, 0.5, 2, 4 mg/kg) and d-amphetamine (0, 0.25, 0.5, 1 mg/kg) on play fighting (instances of boxing, tail-pulling, wrestling, pinning, aggressive grooming) and chasing in
rats. The researchers found that both drugs significantly decreased play fighting in a dose-dependent manner.

The findings were replicated and expanded in a subsequent study by Beatty, Costello & Berry (1984). Amphetamine was administered to rats alone and in conjunction with a number of other drugs (i.e., catecholamine antagonists, agonists and synthesis inhibitors). As reported previously, amphetamine (0.5 and 1.0 mg/kg) significantly decreased the occurrence of play behaviors (tail pulling, pouncing, boxing, wrestling, pinning, chasing). Interestingly, none of the other drugs (i.e., haloperidol, phenoxybenzamine, chlorpromazine, propranolol, clonidine, alpha-methyltyrosine) altered the play-inhibiting effects of amphetamine. The authors concluded that although amphetamine clearly suppresses play fighting, the exact mechanism through which it does so is unknown.

Thor & Holloway (1983) evaluated the effects of stimulant medication on play-soliciting behaviors in rats. The dependent measures used in the experiment included darting (running with abrupt stopping) and crossovers (climbing over or under the stimulus animal). They found that all doses of d-amphetamine (0.5, 1, 2 mg/kg) significantly decreased the rate of crossovers and darting
and increased the latency to solicit play in a dose-dependent manner. In addition, all doses of methylphenidate (0.5, 1, 2 mg/kg) significantly decreased the frequency of crossovers.

Rats generally exhibit heightened levels of play behavior (i.e. pinning, chasing) following periods of social deprivation (Beatty, Costello & Berry, 1984). Stimulant medications have been shown to block this increase in play in a dose-dependent manner (Beatty, Costello & Berry, 1984; Beatty et al., 1982, Thor & Holloway, 1983).

The Effects of Stimulants on Related Social Behaviors in Rats and Non-Human Primates

Several studies have examined the effects of stimulant drugs on social behavior in rats and non-human primates. Although many of the dependent variables used in these studies are not direct measures of play (e.g., social interaction), they are important in that they may be considered prerequisites for social play behaviors.

Gambill and Kornetsky (1976) investigated the effects of stimulants on a number of social behaviors in rats. In this study, the researchers placed amphetamine treated rats in cages with unfamiliar rats. Dependent measures included rates of grooming, feeding, sex, sleeping, stereotypy,
agonistic behavior and their positioning (i.e., proximal or distal) in relation to other rats. Amphetamine (8.0mg/kg) significantly decreased the rate at which rats engaged in social/agonistic behaviors. In addition, amphetamine-treated rats tended to remain distal from other rats.

Arakawa (1994) used a similar paradigm to investigate the effects of stimulant drugs on the social behavior of rats. Rats were injected with saline, and a range of doses of methamphetamine or methylphenidate (0.008 - 5.0 mg/kg). The treated rats were then placed in an open field either alone or with an untreated rat. It was found that methylphenidate at doses of 1.0 mg/kg or greater caused rats to remain separate in the field.

Steinpreis, Sokolowski, Papanikolaou and Salamone. (1994) used an intruder paradigm to evaluate the effects of stimulant drugs in rats. This paradigm involves placing an unfamiliar rat in a cage with an established colony containing three other rats. For the purpose of this study, the intruder rat was injected with either amphetamine or placebo. The researchers found that amphetamine (4.0 mg/kg) substantially reduced the occurrence of social behaviors in the treated rats, including the number of social threats initiated by the intruder rat, the frequency of side
mounting, as well as the occurrence of crawling under other rats.

Researchers have also investigated the effects of stimulant drugs on the social behavior of nonhuman primates. Schlemmer & Davis (1981) found that chronic administration of d-amphetamine (3.2 mg/kg daily for 12 days) significantly increased the number of submissive gestures in stumptail macaque monkeys. Thierry Steru, Chermat and Simon (1984) evaluated the effects of d-amphetamine on the greeting behavior of rhesus monkeys. In this experiment, the researchers observed the social interactions of pairs of d-amphetamine treated juvenile rhesus monkeys that had been reunited after a separation of two days. Dependent measures included greeting behavior (social grooming, social play, and huddling) and frequency of presentations and mounts. It was found that that d-amphetamine (0.1 and 0.2 mg/kg) significantly decreased duration of greeting behaviors.

In another study, Schlemmer, Young and Davis (1996) investigated the effects of amphetamine on the social behavior of stumptail macaque monkeys. Baseline (no drug) observations were conducted on 30 monkeys for 8 days. The monkeys were then treated with d-amphetamine (1.6 mg/kg) for 12 consecutive days. During amphetamine treatment,
monkeys were observed for a 30-second period every five minutes during a 60-minute observation session each day. Dependent measures included stereotypy, proximity to other monkeys, social grooming and submissive behavior. Amphetamine produced a number of profound disruptions in social behavior, including increased submissive behavior, increased stereotypy (specifically self-grooming), and decreased social grooming.

**The Effects of Stimulants on Play – Clinical Research**

There has been a considerable amount of clinical research concerning the effects of stimulant medications on play and related social behaviors in humans. These studies can be organized based on whether they examine stimulant effects on non-social play, social play, or general social behavior.

**Effects on Non-Social Play.** Several studies have investigated the effects of stimulant medication on non-social play in humans. To evaluate the effects of stimulants on attention span and general activity level, researchers often observed children alone in clinic playrooms with a variety of toys. Decreases in movement (i.e., decreased hyperactivity) and fewer toy exchanges or longer duration of toy play (i.e., increased attention...
span) are usually reported as a positive medication response.

Rapaport, Abramson, Alexander and Lott (1971) observed the effects of 10 mg of d-amphetamine on playroom behavior in hyperactive children aged 4 to 10. Children were monitored in a playroom divided into quadrants. The researchers measured the frequency of line crosses (i.e., moving to a different quadrant) and general movement as measured by actometers. They found that d-amphetamine significantly decreased the number of line crosses and ankle movement, indicating that locomotor activity was suppressed during times of play. Although decreases in locomotor activity are considered to be a desired effect of stimulant medication, these decreases in general activity may have an adverse impact on play.

Barkley (1977b) examined the effects of methylphenidate in 36 hyperactive boys aged 5 to 12 in a number of settings. Children were on daily doses ranging from 10-30 mg (mean = 18.6). Dependent measures included number of vocalizations, the frequency of picking up and leaving toys and general activity. In isolated free play conditions, it was found that methylphenidate decreased the amount of wrist movement, ankle movement, and general locomotor activity, indicating that movement during play
was attenuated. In addition, the authors also noted a significant decrease in the number of times medicated children switched toys. Again, these findings are presented as a positive response to methylphenidate (i.e., improved attention span and decreased hyperactivity), yet this positive response may have adverse effects on play.

Barkley & Cunningham (1979a) conducted a study investigating the effects of methylphenidate on activity level and attention span in a number of settings. Participants in this study were 14 hyperactive boys aged 5 to 12. Prescribed doses of methylphenidate averaged 10.5 mg daily. Dependent variables in this study included movement as measured with wrist and ankle actometers, duration of locomotion, activity changes, the mean time engaged in each activity and the number of activities in which they engaged. Results showed that methylphenidate significantly decreased wrist movement as well as the number of different social activities in which treated children engaged.

Handen, McAuliffe, Janosky, Feldman and Breaux (1995) investigated the effects of methylphenidate on developmentally disabled children with concurrent diagnoses of ADHD during periods of independent play. Two doses of methylphenidate (0.3 mg/kg and 0.6 mg/kg) and a placebo control were examined in a within-subjects design.
Dependent measures included frequency and duration of play behavior, physical movement, intensity of play, vocalizations, and the frequency of picking up and leaving toys. It was found that both doses of methylphenidate significantly decreased the intensity of play (i.e., vigorous movement during play), the number of vocalizations, and the amount of movement during play. In addition, the number of toy pickups and toy leaves decreased significantly at the 0.6 mg/kg dose.

**Effects on Social Play.** Some studies have specifically examined the effects of stimulants on social play in humans during interactions between parents and their children with ADHD. Cunningham and Barkley (1978) investigated the effects of 10 mg of methylphenidate on the mother-child interactions of five-year-old hyperactive identical twins in a free-play setting. Researchers placed each child in a small playroom with their mother and measured wrist and ankle movements, the initiation of interactions, the frequency of responses, the occurrence of solitary play, and mother-directed play among other variables. They found that methylphenidate produced a significant decrease in sociability for both boys (i.e., decreased social interaction and increased solitary play).
Barkley & Cunningham (1979b) conducted a similar study with twenty children aged 5 to 12. Experimental conditions included a no drug condition (neither drug nor placebo), placebo, or methylphenidate given at individual prescribed doses (mean = 14.6 mg/daily). Dependent measures included wrist and ankle movement as measured with actometers, the occurrence of mother child interactions, and a parental questionnaire. As reported by other researchers, both ankle and wrist activity decreased significantly while on medication. In addition, children initiated significantly fewer social interactions and responded less to their mothers while on methylphenidate compared to placebo or no drug conditions.

**Effects on Play Related Social Behavior.** Several studies have examined the effects of stimulants on social behavior of preschool children diagnosed with ADHD. Although these studies do not specifically investigate social play, they are relevant because they examine behaviors that may be considered prerequisites for social play, such as social interaction.

Schliefer and colleagues (1975) evaluated the effects of methylphenidate in hyperactive preschool children aged 3 to 5 in unstructured settings. Doses of methylphenidate started at 5 mg and then varied depending on observed
clinical effects. Children were observed in a nursery school setting once each week. Data were taken on specific social behaviors (e.g., aggression) during free-play settings. Nursery school teachers filled out a three-point hyperactivity scale for each participant. The experimenters also employed several psychological tests to evaluate the effects of methylphenidate (i.e., parts of the Cincinatti Test of Preschool Autonomy and the Auditory Continuous Performance Test). Additionally, mothers of the children attending the program were given the Hyperactivity Rating Scale (Werry, 1968). According to parental report, negative behaviors (i.e., noncompliance and aggression) occurred less frequently while on medication. However, the researchers reported that, while receiving methylphenidate, most of the children exhibited a variety of negative side effects including sleep disturbances, increased solitary play, altered mood and decreased social behavior. The researchers determined that stimulant-induced adverse effects on social functioning were sufficiently severe that all but 3 of the 28 participants discontinued use of methylphenidate at the conclusion of the study.

Northup, Gulley, Edwards and Fountain (in press) evaluated the behavioral effects of methylphenidate in three preschool children aged 4 to 6 in different settings.
including a preschool classroom and recess. Dependent measures used in the classroom included out-of-seat behavior, off-task behavior, inappropriate vocalizations, and playing with objects. Social engagement was measured during recess. Social engagement was defined as initiating a social interaction, participating in an interaction, or following the rules of an activity. They found that, in general, methylphenidate was effective for decreasing many disruptive behaviors (i.e. out of seat, inappropriate vocalizations, inappropriate object play) in the classroom. However, they also found that all doses of methylphenidate (0.3 mg/kg, 0.6 mg/kg and 1.0 mg/kg) decreased the occurrence of social engagement during recess in a dose-dependent manner for two of the three children.

A number of additional studies have documented the effects of stimulants on social behavior in school-aged children. Rie and colleagues (1975) conducted a study with “underachieving children” aged 7 to 9 using several different types of rating scales and achievement tests to evaluate the effects of methylphenidate on disruptive behavior and academic achievement. The main findings of this study were that methylphenidate did not improve achievement, but the researchers anecdotally observed a number of negative effects of medication on social
behavior. The authors stated that, while on medication, children, “exhibited little or no initiative or spontaneity, offered little indication of either interest or aversion, showed virtually no curiosity, surprise or pleasure and seemed devoid of humor.” (p. 258). The authors expressed concern regarding the effects of these drug-induced reductions in responsivity on emotional development. It is noteworthy that these children had been prescribed relatively low doses of methylphenidate (5 to 20 mg daily).

Smith, Pelham, Evans, Gnagy, Molina, Bukstein, Greiner, Myak, Presnell & Willoughby (1998) investigated the effects of methylphenidate on social behavior in 46 adolescent children diagnosed with ADHD at a summer treatment facility. Dosages used were 10 mg, 20, or 30 mg in the morning and at lunch. Participants also received a half dose at mid-afternoon (total dosage of methylphenidate for the day was either 25, 50, or 75 mg). Dependent measures focused mainly on social behavior as determined with rating scales completed by counselors and teachers. Overall, many participants exhibited improvements in social behavior while on low doses of methylphenidate. The authors noted, however, that as stimulant dose increased, the beneficial effects of stimulants decreased, and the risk of
social side effects, including social withdrawal and increased listlessness, increased significantly.

Stimulant drugs have been shown to produce significant disruptions in the social behavior of developmentally disabled individuals with ADHD. Helsel, Hersen, Lubetsky, Fultz, Sisson & Harlovic (1989) investigated the effects of stimulants on behavior in both structured and unstructured social settings for four mentally retarded children aged 4 to 8 with concurrent diagnoses of ADHD. Several dosages of methylphenidate were varied for each of the participants, with doses ranging from 0.3 to 0.9 mg/kg. Assessment procedures included a direct classroom observation during academics, performance measures, affect rating measures, and teacher rating scales (i.e., Connors Teacher Rating Scale). In the classroom observation, dependent measures included the occurrence of on-task behavior, in-seat behavior, and talking out. Performance measures included task accuracy and latency to task completion. As has been established in many studies, they found that increasing doses of methylphenidate improved on-task behavior. Anecdotally, however, they noted a number of dose-related negative changes in social behavior for all four participants. One participant who was informally evaluated for side effects exhibited severe social withdrawal and was
described as non-interactive while on the 0.6 mg/kg dose of methylphenidate. The researchers did not systematically evaluate the stimulant-related side effects in this study.

Another study with developmentally disabled children with concurrent diagnoses of ADHD was conducted by Handen and colleagues (1995). Participants were 27 children aged 6 to 12. The medication conditions in the study included placebo and two doses of methylphenidate (0.3 mg/kg and 0.6 mg/kg). The researchers used a six-point 13-item rating scale to determine the presence of side effects in the participants. Measures on this scale included, motor movements, drowsiness, sadness, staring, moodiness, irritability, social withdrawal, anxiety, dizziness, stomachaches, headaches, poor appetite, and activity level. Although they were unable to detect any consistent pattern of behavioral side effects, two subjects exhibited severe social withdrawal on the 0.3 mg/kg dose.

Rationale for the Current Study

The primary purpose of the current study was to evaluate the effects of stimulant medications on the play and social behavior of children during an unstructured recess setting, a structured play condition, and an alone play condition. Children receiving the extended-release stimulant medication, Concerta, were observed an additional
time in the afternoon to evaluate its effects over longer periods of time. There have been few studies attempting to document the effects of stimulant medications in unstructured settings. Of the studies including observations in unstructured settings, none have specifically observed the effects of stimulants on behaviors related to social play.

Another goal in the current study was to investigate the effects of stimulant medications on the reinforcing properties of social behavior and play by using a concurrent-operants reinforcer assessment procedure (i.e., Northup, George, Jones & Broussard, 1996; Northup, Fusilier, Swanson, Roane & Borrero, 1997) to determine if stimulants altered the reinforcing value of play and/or social interaction. Given that stimulants have been shown to decrease the occurrence of play and related social behaviors in rats and non-human primates, it is possible that children taking these drugs may be less likely to choose social play as a reinforcer.

There were a number of secondary goals for the present study. The first of which was to document the effects of stimulants on social behavior in both structured and unstructured play settings. It is possible that the structured or unstructured nature of the activity may
influence the effects of stimulant medication on social behavior. Another goal was to document the effects of stimulants on play behavior in solitary settings. This condition enables comparison between the effects of stimulants on behavior in solitary play settings and structured and unstructured social play settings. The final objective was to evaluate the accuracy of both teachers and participants in reporting the presence of side effects. This was evaluated with a teacher rating scale, a child rating scale and a structured child interview.
Participants and Setting

Five children between the ages of 4 and 6 participated in the current study. All participants were enrolled in the Summer Treatment and Research Program (STAR Program) at Louisiana State University. Enrollment in the program required a prior diagnosis of ADHD based on the criteria of the Diagnostic and Statistical Manual for Mental Disorders (DSM-IV, American Psychiatric Association, 1994). In addition, a consulting psychiatrist provided independent confirmation that the children met the DSM-IV criteria for ADHD based on parent interviews and scores at least two standard deviations above established norms on either the ADHD Rating Scale (DuPaul, 1991) or the Connors Hyperactivity Scale (Connors, 1973). This study was conducted in conjunction with IRB approved medication evaluation procedures funded with a NIH grant.

Response Definitions

Data were collected for a variety of dependent variables across each of the three play conditions (i.e., recess, sports training and alone play). Dependent variables were defined as follows:

1) Toy/object play. Defined as any touching of a toy (or object) during the interval.
2) Solitary play. Defined as engaging in playful activities (i.e. toy/object play) without peers for at least five seconds during the interval. The appropriateness of the play was documented as well. Inappropriate play included such behaviors as property destruction.

3) Social play. Defined as engaging in cooperative activities with peers (i.e. throwing a ball back and forth, playing games) for at least five seconds during the interval. The appropriateness of social play was documented as well. Inappropriate social play included such behaviors as property destruction, cheating, and aggression.

4) Nonsocial vocalizations. Defined as vocalizations made by the child that were not directed at others, such as humming or whistling.

5) Social vocalizations. Defined as vocalizations directed at either peers or the recess monitor. Occurrences of inappropriate vocalizations, such as name calling or complaining, were documented.

6) High activity level. Defined as the child walking, running and/or jumping for at least five seconds of the interval.
7) Game participation. Defined as the child remaining oriented to the game (i.e., looking at the ball) for at least five seconds of the interval.

8) Anxiety/stereotyped behavior. Defined as any instances of crying, whining, nail biting, somatic complaints, gratuitous hand movements (i.e., hand flapping) or skin picking.

9) Number of escape attempts. Defined as any attempts or requests to leave the designated play area.

10) Social withdrawal. Defined as the child not interacting or playing with peers and is at least three feet from others for the entire ten second interval.

11) Steps taken. Defined as the number of steps taken as measured with digital pedometers attached to the waist of each child. A second pedometer was worn by each child to measure the reliability of the instruments.

Side Effects Measures. Side effects measures were completed by the recess monitor/classroom teacher and each participant daily. A side effect questionnaire was developed from the items from Barkley’s Stimulant Drug Side Effects Rating Scale (Barkley, 1981). However, items specific to play and social behavior were added (See Appendices A and B).
**Self Report Measure.** Summer program staff members conducted a brief structured interview for each participant while taking each dose of stimulant medication (See Appendix C). The self-report measure contained items designed to assess if the children understood why they were taking the medication and to provide information regarding the child’s own perception of medication effects. This measure represented a qualitative index of the childrens’ perception of medication effects.

**Data Collection and Measurement**

Data were collected daily for six weeks during the summer treatment program. Participants were observed for ten-minute periods during unstructured (recess), structured (sports training), and alone conditions as described below. Each ten-minute observation was divided into 60 ten-second intervals. Both partial (i.e., any instance of the behavior occurring in the interval) and whole (i.e., instances of the behavior lasting for the entire interval) interval recording was used for the dependent variables. Partial interval data were recorded for most of the dependent measures including: toy/object play, solitary and social play, social and nonsocial vocalizations, high and low activity levels, game participation, escape attempts and anxiety behavior. Whole interval recording was used for the
measurement of social withdrawal. Frequency data were taken for the number of steps taken and were measured with an electronic pedometer attached to the waist of each participant during all play conditions. The electric pedometers approximate the number of steps taken.

Interobserver reliability data were collected for all play conditions in the current study. Observers were trained to at least 80% agreement before beginning the study. For the recess observations, reliability data were collected for 33.3% of sessions. Agreement for the recess condition was 84.6% with a range from 50.0% to 100.0% across all dependent variables. Agreement was determined by taking the number of intervals in which there was agreement for all of the variables, divided by the total number of possible intervals and then multiplied by 100.

For the sports training observations, reliability data were collected for 36.0% of sessions. Agreement for the sports training condition was 85.9% with a range from 66.7% to 100.0%.
For the alone play observations, reliability data were collected for 52.8% of sessions. Agreement for the alone play observations was 93.3% ranging from 75.0% to 100.0%.

Reliability data were collected for 33.8% of the sessions in the reinforcer assessment. Agreement for the reinforcer assessment was 100.0% for all sessions.

Procedure

Unstructured recess. The unstructured recess was a 15-minute free-play condition conducted outdoors. Recess was available to all children attending the summer treatment program (n=12), although data were only collected for the children participating in the current study. Children were restricted to an 80 x 30 foot play area for observations. Several common toys were made available for the participants to play with (Bouncy Balls, plastic trucks/cars, plastic baseball bat, etc.). Observers remained outside the designated play area to minimize extraneous social contact with the participants. A recess monitor (the classroom teacher) was present in the recess area to redirect children in cases of immediate harm to self or others, or attempts to leave the designated play area. Dependent variables for the recess setting included toy/object play, social and nonsocial play, social and nonsocial vocalizations, activity level, anxiety behavior,
escape attempts, social withdrawal and number of steps taken.

**Structured Sports Training.** The structured sports training condition was a behavior management program designed to teach sportsmanship and social skills to children with ADHD. This program was conducted daily for six weeks during the summer treatment program. Sportsmanship skills (i.e., clapping, cheering) were trained during games of kickball. All children in the summer treatment program were involved in the sports training program, but for the purpose of the current investigation, data were collected for only the six participants in this study. Data collectors remained outside of the playing area to minimize social contact with the children. Dependent variables measured in this condition included game participation, social and nonsocial vocalizations, high activity level, escape attempts, anxiety behavior and number of steps taken.

**Alone play.** Alone play conditions were conducted daily for six weeks during the summer treatment program. In this condition, the children were placed alone in a room with a number of common toys. They were told that someone would be back for them in “a little while” and to do whatever they would like. Observers collected data in an
adjacent room from behind a two-way mirror. Dependent variables for this condition included toy/object play, nonsocial vocalization, high activity level, escape attempts and number of steps taken.

**Tiger Camp Observations.** Due to its extended duration of action, children taking the stimulant, Concerta, were observed at additional times during Monday, Wednesday, and Friday afternoons while attending another summer program. The children were observed during play conditions similar to the morning recess or sports training conditions. Data were not collected on days in which children were not engaged in play activities (i.e., arts and crafts). Although the onset of behavioral effects for Concerta is expected in the same time as the short-acting preparation of methylphenidate (within 30 minutes to an hour), peak plasma concentrations of Concerta occur six to eight hours after administration. Thus, the peak effects occur early in the afternoon. Children were observed for ten minutes, as was the case in the morning recess and sports conditions. The dependent measures in the afternoon observations included game participation, social and nonsocial vocalizations, activity level, anxiety/stereotyped behavior, escape attempts, and social withdrawal.
**Reinforcer assessment.** A social reinforcer assessment was conducted for five of the children during the study. Assessment procedures were based on those of Northup, et al. (1996) and Northup, et al. (1997). During baseline, children were presented with a nonpreferred task (i.e. placing blocks in a bucket). The experimenter then instructed the participant to place as many or few blocks in the bucket as they would like. The average number of blocks placed in the bucket during baseline was used as the criterion level to earn token coupons in the reinforcer assessment condition. During the assessment condition, the participants had to place the criterion number of blocks in the bucket to earn one of three coupons for a preferred item, including a “play alone” coupon, a “play with friends” coupon and a “quiet time” coupon. The children had the opportunity to earn as few or as many coupons as they would like within a five-minute period. Each “play alone” coupon could be exchanged for the opportunity to play with a number of toys in a room alone for two minutes. Each “play with friends” coupon could be exchanged for the opportunity to play with a friend for two minutes. Each “quiet time” coupon could be exchanged for the opportunity to read, sit in a chair quietly or rest quietly on a couch for two minutes. Neither toys nor peers were available to
the participant in this condition. Immediately following each assessment, children were able to “cash in” their coupons by handing the cards to the experimenter. The type of coupon, as well as the order in which they were cashed in, were recorded.

**Rating Scales/Child Interview.** One teacher rating scale for each participant was given to the classroom teacher to be completed at the end of each day. The teacher was required to complete the questionnaires before leaving each day. A child rating scale was administered to each participant daily. Additionally, a child interview was conducted once while on each dose for each participant (i.e., once while on placebo and once for each medication dose condition). Both the child rating scale and the child interview were conducted in a quiet room with only the therapist and child present.

**Medication Status**

Participants received one of three previously prescribed stimulant medications in this study. A consulting child psychiatrist prescribed an alternating course of placebo (i.e., sugar pills in capsule form) and one dose of either Dexedrine (n=1), Adderall (n=2) or Concerta (n=2) for each of the participants. One participant received an alternating course of placebo and
two doses of Concerta (36 mg and 54 mg). There were two or three possible dose conditions for each participant (1 to 2 medication dose levels and a placebo dose) during the experiment. Two participants received Adderall in the current study. One participant (Ruby) received 10 mg (0.4 mg/kg) while another (Eric) received 20 mg (0.8 mg/kg). These doses of Adderall were the doses of medication that had been prescribed prior to their admission to the summer program and are representative of doses that are commonly prescribed in clinical practice. One participant (Brad) received 20 mg (0.8 mg/kg) of d-amphetamine (Dexedrine). This participant had been prescribed this dose of Dexedrine before his admission to the summer program. Three participants received doses of Concerta. One participant (Jack) received 36 mg (1.6 mg/kg) while another (Randy) received 54 mg (2.4 mg/kg). The third participant receiving Concerta was given two doses: 36 mg (1.6 mg/kg) and 54 mg (2.4 mg/kg). For the first two participants receiving Concerta, doses used were prescribed before their admission to the summer program. The third participant had been prescribed 36 mg of Concerta prior to his admission to the summer program. During the summer program, the consulting psychiatrist increased the dose to 54 mg. Doses of Concerta for all participants were doses that are commonly used in
clinical practice. With the exception of the director of the program, all observers were blind to the medication dose. All drug conditions were compared to placebo. The director of the program provided the parents with instructions each day regarding medication dose for the following day. Medication status as well as the time of administration, were verbally confirmed with the parents each morning.

**Design**

Medication status was alternated daily in a multielement single case design (Sidman, 1960) and the results were graphed and evaluated via visual inspection (Kazdin, 1982). The multielement design was an alternating course of treatment (i.e., stimulant medication) and non-treatment (i.e., placebo) that was rotated in a semi-random manner. The alternation of dose conditions was not completely random in an effort to have similar numbers of observations for each dose condition. The differences between dosage levels of each given medication were evaluated with a randomization test which randomly assigns observations of the dependent variable (e.g., percentage of intervals) to the conditions of the independent variable (e.g., drug dose or placebo) and then calculates an F-test thousands of times until a stable, random distribution of
F-tests is created (Edgington, 1996). The F-test produced by the actual results of the individual is then compared to the randomized F-test distribution to determine the chance probability of the actual results. The randomization test is well suited for single-subject designs (i.e., multielement designs) given that it does not involve many of the assumptions for population-based statistical tests (i.e., normal distribution, independence of samples).

To illustrate how the randomization test functions, a simple example will be provided. In the current example, seven observations are conducted with a given participant. Three of the seven observations represent a control condition (i.e., placebo) and four represent an experimental condition (i.e., stimulant dose). The scores from the control condition are 17, 21, and 23 on a given dependent variable (i.e., percent of intervals with social withdrawal). The scores from the experimental condition are 22, 25, 25, and 26. If the null hypothesis is true, the scores should have an equal probability of being in the control or experimental condition. That is, the values are “interchangeable”. The randomization test calculates all possible combinations of the 7 observations in one group of 3 and another group of 4 (there are 35 such arrangements in the current example). The relevant test statistic is created
for each arrangement, and the statistic obtained is compared to that reference distribution (usually referred to as a sampling distribution with parametric tests). The null hypothesis is then either rejected or retained. In the present example, there is only one arrangement of the data that would have a smaller mean for control condition and a larger mean for the experimental condition. The difference obtained in the current example would occur only 2 times out of 35, for a probability of approximately .1142.
CHAPTER 3: RESULTS

Experiment 1 – Unstructured Recess

Eric. Eric exhibited a significant increase in the number of intervals of social vocalizations (from 39.9 to 58.9% of intervals) while on medication (p<0.01) (See Table 1 and Appendix D, Figure 4).

Brad. Brad demonstrated no significant medication effects for any of the variables measured during the recess condition (See Table 1 and Appendix D).

Ruby. Ruby exhibited fewer intervals with social vocalizations/Attempts at social contact while on medication during the recess condition (35.2 to 16.0% of intervals; p<0.001) (See Table 1 and Appendix D, Figure 4).

Randy. A significant medication effect was observed for toy play during the recess period for Randy. Medication significantly increased the number of intervals Randy engaged in toy play (76.8 to 91.9% of intervals; p<0.05) (See Table 1 and Appendix D, Figure 1).

Jack. Jack demonstrated no significant medication effects for any of the variables measured during the recess condition (See Table 1 and Appendix D).

Rick. A number of significant medication effects were observed for Rick during the recess condition at both the
low (36 mg) and high (56 mg) Concerta dose. Rick exhibited a significant decrease in the number of intervals with toy play from 85.0 to 11.0% of intervals while on the high dose of Concerta (p<0.001) (See Table 1 and Appendix D, Figure 1). Additionally, the high dose of Concerta produced a decrease in solitary play (51.7 to 3.1%, p<0.001) (See Table 1 and Appendix D, Figure 3). The high dose produced a decrease in activity level from 59.1 to 14.6% of intervals (p<0.001) (See Table 1 and Appendix D, Figure 6). The high dose of Concerta produced a significant increase in anxiety/stereotyped behavior from 1.3% to 45.6% of intervals (p<0.001) (See Table 1 and Appendix D, Figure 7). Both doses of Concerta produced significant decreases in the occurrence of escape attempts. The high dose of Concerta decreased the number of intervals with escape attempts from 4.0% to 0.0% (p<0.01). The low dose of Concerta decreased the number of intervals with escape attempts from 4.0 to 0.0% (p<0.01) (See Table 1 and Appendix D, Figure 8).

**Summary.** For the recess condition, the findings were variable across participants. Both Eric and Ruby exhibited significant medication effects for social vocalizations/

<table>
<thead>
<tr>
<th>Table 1. Unstructured Recess Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eric</strong></td>
</tr>
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40
<table>
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<tr>
<th>Dependent Variable</th>
<th>20 mg Pla</th>
<th>20 mg Add</th>
<th>20 mg Pla</th>
<th>20 mg Dex</th>
<th>10 mg Pla</th>
<th>10 mg Add</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toy Play</td>
<td>64.1%</td>
<td>66.8%</td>
<td>80.0%</td>
<td>69.4%</td>
<td>39.7%</td>
<td>64.0%</td>
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<td>41.5%</td>
<td>51.6%</td>
<td>39.2%</td>
<td>21.3%</td>
</tr>
<tr>
<td>Solitary Play</td>
<td>11.2%</td>
<td>12.0%</td>
<td>45.8%</td>
<td>31.3%</td>
<td>18.3%</td>
<td>44.8%</td>
</tr>
<tr>
<td>Activity Level</td>
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<td>20.1%</td>
<td>30.5%</td>
<td>43.6%</td>
<td>31.3%</td>
<td>29.3%</td>
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<td>Anxiety Behavior</td>
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<td>5.2%</td>
<td>2.1%</td>
<td>4.9%</td>
<td>0.0%</td>
<td>0.0%</td>
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<td>Escape Attempts</td>
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<td>0.0%</td>
<td>0.9%</td>
<td>0.8%</td>
<td>0.3%</td>
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<td>**</td>
<td>22.1%</td>
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<td>35.2%</td>
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<tr>
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<td>6.4%</td>
<td>7.6%</td>
<td>0.5%</td>
<td>0.3%</td>
</tr>
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<td>0.8%</td>
<td>4.9%</td>
<td>10.1%</td>
<td>15.0%</td>
<td>18.7%</td>
</tr>
<tr>
<td>Steps Taken</td>
<td>608.1</td>
<td>523.1</td>
<td>735.3</td>
<td>705.2</td>
<td>415.4</td>
<td>322.0</td>
</tr>
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</table>

* p<0.05
** p<0.01
*** p<0.005
**** p<0.001

Pla = Placebo
Add = Adderall
Dex = Dexedrine

Table 1. (continued)
<table>
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<tr>
<th>Dependent Variable</th>
<th>54 mg</th>
<th>36 mg</th>
<th>36 mg</th>
<th>54 mg</th>
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<tr>
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<td>91.9%</td>
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<td>Social Play</td>
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<td>45.9%</td>
<td>66.7%</td>
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<tr>
<td>Solitary Play</td>
<td>43.5%</td>
<td>50.5%</td>
<td>17.6%</td>
<td>15.0%</td>
</tr>
<tr>
<td>Activity Level</td>
<td>29.2%</td>
<td>41.9%</td>
<td>27.2%</td>
<td>32.1%</td>
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<tr>
<td>Anxiety Behavior</td>
<td>1.2%</td>
<td>3.3%</td>
<td>0.7%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Escape Attempts</td>
<td>12.3%</td>
<td>0.4%</td>
<td>1.8%</td>
<td>1.6%</td>
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<td>47.3%</td>
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<td>Nonsocial Vocals</td>
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<td>3.6%</td>
<td>1.5%</td>
<td>1.6%</td>
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<tr>
<td>Social Withdrawal</td>
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<td>11.5%</td>
<td>8.0%</td>
<td>2.5%</td>
</tr>
<tr>
<td>Steps Taken</td>
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<td>670.0</td>
<td>818.5</td>
<td>801.9</td>
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</table>

* p<0.05  
** p<0.01  
*** p<0.005  
**** p<0.001  
Pla = Placebo  
Con = Concerta
social interactions. Stimulant dose produced a 46.2% increase in the number of intervals with social vocalizations for Eric while Adderall produced a 54.5% decrease in the number of social interaction/attempts at social contact attempts made by Ruby. Randy demonstrated a significant 19.7% increase in the number of intervals of toy play.

Rick displayed a number of significant medication effects while receiving the high dose of Concerta, including an 87.1% decrease in toy play, a 92.2% decrease in solitary play, a 69.6% decrease in locomotor activity, a 100.0% decrease in escape attempts as well as significant increases in anxiety/stereotyped behaviors (508.0% increase). These findings clearly indicate that the high dose of Concerta produced a number of detrimental social effects for Rick.

Experiment 2 – Structured Sports Training

Eric. A significant medication effect was observed for Eric during the sports training condition. Medication dose increased game participation from 82.2 to 94.7% (p<0.05) (See Table 2 and Appendix E, Figure 1).

Brad. Brad exhibited a number of significant medication effects during the sports training condition. While on medication (20 mg Dexedrine), Brad displayed a
significant increase in game participation (56.4% to 84.2% of intervals; p<0.001) (See Table 2 and Appendix E, Figure 1). Medication also produced a significant decrease in activity level as measured by the percentage of intervals with high activity as well as the number of steps taken. During the kickball game, the percentage of intervals with high activity decreased from 33.1% to 18.4 % (p<0.01) (See Table 2 and Appendix E, Figure 4) while the number of steps taken decreased from 842.3 to 375.2 steps (p<0.005) (See Table 2 and Appendix E, Figure 7). A mild, but consistent increase in anxiety/stereotyped behavior (2.1 to 9.0% of intervals) was also observed while Brad was on Dexedrine (p<0.005) (See Table 2 and Appendix E, Figure 5).

Ruby. Ruby demonstrated no significant medication effects for any of the variables measured during the sports training condition (See Table 2 and Appendix E).

Randy. Randy exhibited a number of significant medication effects during the sports training condition, including a significant increase in game participation (from 49.9 to 76.0% of intervals; p<0.05) (See Table 2 and Appendix E, Figure 1) and a significant increase the number of intervals containing anxiety/stereotyped behavior (from 2.0 to 11.6%; p<0.05) (See Table 2 and Appendix E, Figure 5). Escape attempts decreased from 16.6 to 1.0% of
intervals while on Concerta (p<0.05) (See Table 2 and Appendix E, Figure 6).

Jack. Jack demonstrated no significant medication effects for any of the variables measured during the sports training condition (See Table 2 and Appendix E).

Rick. Several significant effects were observed for Rick at both the high and low doses of Concerta during the sports training condition. Both doses of medication produced significant increases in game participation (See Table 2 and Appendix E, Figure 1). The low dose of Concerta increased participation from 30.4 to 70.0% of intervals (p<0.005). The high dose increased game participation from 30.4 to 86.4% of intervals (p<0.001). Both doses of Concerta produced significant decreases in social vocalizations during the sports training condition (See Table 2 and Appendix E, Figure 2). The low dose decreased social vocalizations from 36.0 to 18.6% of intervals (p<0.05). The high dose of Concerta decreased social vocalizations from 36.0% to 11.6% of intervals (p<0.01). Significant increases in anxiety/stereotyped behavior were observed for both dose conditions as well (See Table 2 and Appendix E, Figure 5). The low dose of Concerta produce an increase in the number of intervals of anxiety behavior from 6.1% to 31.9% of intervals (p<0.05). The high dose
increased anxiety behavior from 6.1% to 66.6% of intervals (p<0.001).

Summary. In the sports training condition, a number of significant medication effects were observed. Four of the six participants demonstrated significant increases in game participation (Brad, Randy, Eric and Rick). However, for three of these four children, a corresponding increase in the amount of anxiety/stereotyped behavior was observed while on their prescribed dose of medication (Brad, Randy and Rick). Although there did appear to be an increase in anxiety behavior for Eric while on Adderall (1.5% to 16.1% of intervals), the findings were not statistically significant (p=0.06).

A number of idiosyncratic effects were observed for several of the participants in the sports training setting as well. For instance, Rick exhibited a significant decrease in the number of social vocalizations made during the game at both the high and low dose of Concerta (53.2% decrease for the low dose and 67.8% decrease for the high dose). Brad displayed a significant decrease in locomotor activity during the sports training condition.
Table 2. Structured Sports Training Observations

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Eric</th>
<th>Brad</th>
<th>Ruby</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>20 mg</td>
<td>20 mg</td>
<td>10 mg</td>
</tr>
<tr>
<td></td>
<td>Pla</td>
<td>Add</td>
<td>Pla</td>
</tr>
<tr>
<td>Game Particpnt</td>
<td>82.2%</td>
<td>94.7%</td>
<td>56.4%</td>
</tr>
<tr>
<td>Social Vocals</td>
<td>28.7%</td>
<td>24.4%</td>
<td>26.9%</td>
</tr>
<tr>
<td>Nonsocial Vocals</td>
<td>0.7%</td>
<td>0.9%</td>
<td>18.4%</td>
</tr>
<tr>
<td>Activity Level</td>
<td>10.7%</td>
<td>10.3%</td>
<td>33.1%</td>
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<tr>
<td>Anxiety Behavior</td>
<td>1.5%</td>
<td>16.1%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Escape Attempts</td>
<td>1.2%</td>
<td>0.0%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Steps Taken</td>
<td>346.2</td>
<td>307.6</td>
<td>842.3</td>
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<table>
<thead>
<tr>
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<th>Randy</th>
<th>Jack</th>
<th>Rick</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>54 mg</td>
<td>36 mg</td>
<td>36 mg</td>
</tr>
<tr>
<td></td>
<td>Pla</td>
<td>Con</td>
<td>Pla</td>
</tr>
<tr>
<td>Game Particpnt</td>
<td>49.9%</td>
<td>76.0%</td>
<td>92.3%</td>
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<td>Social Vocals</td>
<td>30.1%</td>
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<td>Anxiety Behavior</td>
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<td>0.6%</td>
</tr>
<tr>
<td>Escape Attempts</td>
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<td>1.0%</td>
<td>1.8%</td>
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<tr>
<td>Steps Taken</td>
<td>457.6</td>
<td>236.1</td>
<td>600.3</td>
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</table>

* p<0.05
** p<0.01
*** p<0.005
**** p<0.001

Pla = Placebo
Con = Concerta
Add = Adderall
Dex = Dexamethasone
**Experiment 3 - Alone Play**

**Eric.** Medication dose produced a significant effect on locomotor activity in the alone play condition for Eric. Adderall decreased activity level from 18.4 to 5.3% of intervals (p<0.05) (See Table 3 and Appendix F, Figure 3) as well as the number of steps taken from 372.2 to 183.6 steps (p<0.05) (See Table 3 and Appendix F, Figure 6).

**Brad.** Brad exhibited significant medication effects during alone play sessions. A significant decrease in intervals with vocalizations was observed while Brad was on Dexedrine. Vocalizations decreased from 38.0 to 5.9% of intervals while on medication (p<0.01) (See Table 3 and Appendix F, Figure 2). Additionally, Dexedrine decreased the number of steps taken from 187.6 to 105.3 (p<0.05) (See Table 3 and Appendix F, Figure 6).

**Ruby.** Ruby demonstrated no significant medication effects for any of the variables measured during the alone play condition (See Table 3 and Appendix F).

**Randy.** Randy demonstrated no significant medication effects for any of the variables measured during the alone play condition (See Table 3 and Appendix F).

**Jack.** Jack demonstrated no significant medication effects for any of the variables measured during the alone play condition (See Table 3 and Appendix F).
Table 3. Alone Play Observations

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Eric 20 mg</th>
<th>Brad 20 mg</th>
<th>Ruby 10 mg</th>
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<tbody>
<tr>
<td>Toy Play</td>
<td>97.9%</td>
<td>95.9%</td>
<td>94.8%</td>
</tr>
<tr>
<td>Vocals</td>
<td>3.8%</td>
<td>0.9%</td>
<td>38.0%</td>
</tr>
<tr>
<td>Activity Level</td>
<td>18.4%</td>
<td>5.3%</td>
<td>8.5%</td>
</tr>
<tr>
<td>Anxiety Behavior</td>
<td>0.3%</td>
<td>6.0%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Escape Attempts</td>
<td>0.7%</td>
<td>0.6%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Steps Taken</td>
<td>372.2</td>
<td>183.6</td>
<td>187.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Randy 54 mg</th>
<th>Jack 36 mg</th>
<th>Rick 36 mg 54 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toy Play</td>
<td>99.3%</td>
<td>90.1%</td>
<td>95.5%</td>
</tr>
<tr>
<td>Vocals</td>
<td>33.6%</td>
<td>22.4%</td>
<td>21.9%</td>
</tr>
<tr>
<td>Activity Level</td>
<td>9.8%</td>
<td>8.4%</td>
<td>17.3%</td>
</tr>
<tr>
<td>Anxiety Behavior</td>
<td>0.0%</td>
<td>0.2%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Escape Attempts</td>
<td>0.0%</td>
<td>0.2%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Steps Taken</td>
<td>172.8</td>
<td>106.1</td>
<td>359.4</td>
</tr>
</tbody>
</table>

* p<0.05  
** p<0.01  
*** p<0.005  
**** p<0.001

Pla = Placebo  
Con = Concerta  
Add = Adderall  
Dex = Dextedrine
Rick. Rick demonstrated no significant medication effects for any of the variables measured during the alone play condition (See Table 3 and Appendix F).

Summary. Relatively few significant medication effects were observed in the alone play condition. Two of the six participants demonstrated significant decreases in locomotor activity while taking their prescribed dosage of medication. For Eric, both the number of intervals of high activity and the number of steps taken decreased significantly while taking Adderall. For Brad, the number of steps taken during alone conditions decreased as well. Another idiosyncratic finding was the decrease in the number of vocalizations made by Brad while on Dexedrine.

Experiment 4 – Tiger Camp Observations

Randy. Randy displayed higher levels of game participation while on medication (45.0% to 86.0% of intervals, 91.1% increase) during the Tiger Camp observation (See Table 4 and Appendix G, Figure 1). Additionally, higher levels of anxiety/stereotyped behavior were observed while on medication (7.0% to 22.0% of intervals, 214.3% increase) for Randy (See Table 4 and Appendix G, Figure 5).
Table 4. Tiger Camp Observations

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Randy 54 mg</th>
<th>Jack 36 mg</th>
<th>Rick 36 mg</th>
<th>Rick 54 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game Participtn</td>
<td>45.0</td>
<td>86.0</td>
<td>60.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Social Vocals</td>
<td>3.0</td>
<td>18.2</td>
<td>13.5</td>
<td>27.7</td>
</tr>
<tr>
<td>Activity Level</td>
<td>15.0</td>
<td>19.2</td>
<td>16.7</td>
<td>21.3</td>
</tr>
<tr>
<td>Anxiety Behavior</td>
<td>7.0</td>
<td>22.0</td>
<td>3.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Escape Attempts</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Social Withdrawal</td>
<td>0.0</td>
<td>1.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Pla = Placebo
Con = Concerta
Add = Adderall
Dex = Dexedrine

**Jack.** Jack demonstrated no significant medication effects for any of the variables measured during the Tiger Camp observations (See Table 4 and Appendix G).

**Rick.** Rick displayed higher levels of game participation while on medication (an increase from 78.5% on placebo to 100.0% for both the low and high dose, 24.7% increase) (See Table 4 and Appendix G, Figure 1).

**Summary.** In summary, there were relatively few significant findings for the Tiger Camp observations. Additionally, the findings that were significant must be interpreted with caution due to the limited number of
observations conducted. Due to the limited number of observations, statistical tests could not be conducted.

Experiment 5 – Social Reinforcer Assessment

Eric. Significant medication effects were observed during the social reinforcer assessment for Eric. He selected a greater proportion of peer play coupons while taking Adderall (83.3% as compared to 71.8%). In addition, the number of alone play coupons selected decreased while on Adderall (28.2% to 16.7%). Eric selected fewer total coupons (3.9 as compared to 3.0) while taking the prescribed dose of medication (See Table 5 and Appendix H, Figures 4 and 5).

Brad. Significant medication effects were observed in the social reinforcer assessment for Brad. He displayed a significant decrease in number of peer coupons selected while taking Dexedrine (86.5% to 63.9%). In addition, a corresponding increase in the number of quiet time coupons selected (8.1% to 27.8%) was observed while he was on medication (See Table 5 and Appendix H, Figure 5).

Randy. Some minor medication effects were observed during the social reinforcer assessment for Randy. Concerta decreased the percentage of peer coupons selected from 100.0% to 90.5%. Medication dose also produced a slight increase in the amount of alone and quiet coupons selected
(from 0.0% to 2.4% for alone coupons and from 0.0% to 7.1%, respectively) (See Table 5 and Appendix H, Figure 5).

Jack. No significant medication effects were observed for the type of coupons selected by Jack during the reinforcer assessment. The total daily number of coupons selected by Jack increased from 3.5/day to 4.9/day (a 40.0% increase) while on Concerta (See Table 5 and Appendix H, Figure 4).

Rick. Rick exhibited a number of significant medication effects during the social reinforcer assessment. Rick selected significantly fewer peer coupons while on the high dose of Concerta (67.7% to 40.0% of coupons). Furthermore, a corresponding increase in alone play coupon selection was observed while Rick was on the high dose of Concerta (32.3% to 53.3% of coupons). Peer play coupons were selected at the highest rate while on the low dose of Concerta (86.7%). Additionally, alone coupons were selected at the lowest rate while on the low medication dose (13.3%) (See Table 5 and Appendix H, Figure 5).

Summary. A number of significant medication effects were observed during the social reinforcer assessment. Brad and Rick exhibited pronounced decreases in the number of peer play coupons selected while on the high dose of medication. The number of peer play coupons selected by
Brad decreased by 28.1% while taking his prescribed dose of Dexedrine. The number of peer play coupons selected by Rick decreased by 42.9% while taking the high dose of Concerta. Additionally, a corresponding increase in the number of alone play coupons (Rick) or quiet time coupons (Brad) was observed. The number of alone play coupons selected by Rick increased from 1.0 to 1.6 (60.0% increase) at the high dose of Concerta. Brad displayed an increase in the number of quiet time coupons while taking Dexedrine (0.3 to 1.0 coupons daily, 233.3% increase). Another participant (Randy) appeared to exhibit a mild decrease in the number of peer play coupons while on medication (4.3 to 3.8 coupons daily, 11.6% decrease).

One participant (Eric) selected more peer play coupons while receiving his prescribed dose of medication. In addition, a corresponding decrease in the number of alone play coupons was observed while taking Adderall. These findings indicate that, for Eric, stimulant medication may have increased the reinforcing value of social play.
<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Eric (20 mg)</th>
<th>Brad (20 mg)</th>
<th>Randy (54 mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer Play</td>
<td>2.8 (71.8%)</td>
<td>2.5 (83.3%)</td>
<td>3.2 (86.5%)</td>
</tr>
<tr>
<td>Alone Play</td>
<td>1.1 (28.2%)</td>
<td>0.5 (16.7%)</td>
<td>0.2 (5.4%)</td>
</tr>
<tr>
<td>Quiet Time</td>
<td>0.0 (0.0%)</td>
<td>0.0 (0.0%)</td>
<td>0.3 (8.1%)</td>
</tr>
<tr>
<td>Total</td>
<td>3.9 (100%)</td>
<td>3.0 (100%)</td>
<td>3.7 (100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Jack (36 mg)</th>
<th>Rick (36 mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peer Play</td>
<td>3.5 (100%)</td>
<td>4.9 (100%)</td>
</tr>
<tr>
<td>Alone Play</td>
<td>0.0 (0.0%)</td>
<td>0.0 (0.0%)</td>
</tr>
<tr>
<td>Quiet Time</td>
<td>0.0 (0.0%)</td>
<td>0.0 (0.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>3.5 (100%)</td>
<td>4.9 (100%)</td>
</tr>
</tbody>
</table>

Pla = Placebo
Con = Concerta
Add = Adderall
Dex = Dexedrine
Teacher Rating Scale

**Eric.** No significant medication effects were noted for Eric on any of the variables from the teacher rating scale (See Table 6).

**Brad.** The teacher scale indicated that Brad was less euphoric/unusually happy (p<0.05) and played alone more frequently while taking medication (p<0.05) (See Table 6).

**Ruby.** A number of significant medication effects were observed for Ruby on the teacher rating scale. According to teacher report, Ruby stared more and daydreamed more frequently (p<0.05), interacted less with others (p<0.05), exhibited increased drowsiness (p<0.005), appeared more sad/unhappy (p<0.05), was less playful with others (p<0.01), played alone more on medication (p<0.01) and appeared more socially withdrawn while on Adderall (p<0.05) (See Table 6).

**Randy.** On the teacher rating scale, a number of significant medication effects were reported for Randy. Randy was reported to stare and daydream more frequently while on Concerta (p<0.05). The teacher also reported that Randy appeared to be less anxious (p<0.05), less euphoric or happy (p<0.01) and played alone less while on medication (p<0.01) (See Table 6).
Jack. No significant medication effects were noted for any of the variables from the teacher rating scale (See Table 6).

Rick. No significant medication effects were noted for any of the variables from the teacher rating scale (See Table 6).

Summary. The findings from the teacher rating scales are especially interesting given that they did not appear to correspond with direct observations from the other phases in the current investigation. It is of particular interest that the child exhibiting the most pronounced social side effects in the direct observations (Rick) had no significant behavioral side effects indicated on the teacher rating scale.

Additionally, it is notable that the lowest functioning child (Ruby) had the highest ratings for medication side effects. According to teacher report, Ruby exhibited a number of detrimental social side effects while taking Adderall (e.g., low levels of social play, increased social withdrawal, increased unhappiness). Again, these findings did not correspond well with the results from the direct observations.
<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Eric 20 mg Pla</th>
<th>Add</th>
<th>Brad 20 mg Pla</th>
<th>Dex</th>
<th>Ruby 10 mg Pla</th>
<th>Add</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Daydreams</td>
<td>0.9</td>
<td>0.8</td>
<td>0.6</td>
<td>1.7</td>
<td>1.33</td>
<td>4.2*</td>
</tr>
<tr>
<td>2. Talks less</td>
<td>1.6</td>
<td>1.4</td>
<td>1.4</td>
<td>2.2</td>
<td>1.5</td>
<td>4.4*</td>
</tr>
<tr>
<td>3. Uninterested</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>2.0</td>
<td>1.83</td>
<td>3.2</td>
</tr>
<tr>
<td>4. Appetite</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>5. Irritable</td>
<td>1.2</td>
<td>1.4</td>
<td>2</td>
<td>1.9</td>
<td>1.5</td>
<td>1.2</td>
</tr>
<tr>
<td>6. Stomachaches</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7. Headaches</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8. Drowsiness</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.3</td>
<td>0.33</td>
<td>3.6***</td>
</tr>
<tr>
<td>9. Sad/unhappy</td>
<td>0.2</td>
<td>0.7</td>
<td>1</td>
<td>1.0</td>
<td>0.67</td>
<td>2.8*</td>
</tr>
<tr>
<td>10. Cry/whine</td>
<td>1.0</td>
<td>1.1</td>
<td>1.5</td>
<td>1.1</td>
<td>1.67</td>
<td>1.8</td>
</tr>
<tr>
<td>11. Anxious</td>
<td>1.5</td>
<td>1.7</td>
<td>1.8</td>
<td>2.5</td>
<td>1.83</td>
<td>1.4</td>
</tr>
<tr>
<td>12. Fingernails</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13. Euphoric</td>
<td>3</td>
<td>2.4</td>
<td>3.1</td>
<td>1.3*</td>
<td>4.5</td>
<td>1.8</td>
</tr>
<tr>
<td>14. Dizziness</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15. Tics</td>
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<td>0.3</td>
<td>0</td>
<td>0</td>
<td>0.17</td>
<td>0</td>
</tr>
<tr>
<td>16. Playful</td>
<td>6.8</td>
<td>6.3</td>
<td>6.1</td>
<td>5.1</td>
<td>4.67</td>
<td>2.2**</td>
</tr>
<tr>
<td>17. Play alone</td>
<td>2</td>
<td>2.5</td>
<td>2.4</td>
<td>4.0*</td>
<td>4.5</td>
<td>7.2**</td>
</tr>
<tr>
<td>18. Withdrawn</td>
<td>1.6</td>
<td>1.8</td>
<td>1.8</td>
<td>1.9</td>
<td>2.83</td>
<td>5.4*</td>
</tr>
<tr>
<td>19. Nail biting</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20. Skin pick</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* p<0.05  
** p<0.01  
*** p<0.005  
**** p<0.001

Pla = Placebo  
Add = Adderall  
Dex = Dexedrine
<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Randy 54 mg</th>
<th>Jack 36 mg</th>
<th>Rick 36 mg</th>
<th>Randy 54 mg</th>
<th>Jack 36 mg</th>
<th>Rick 36 mg</th>
<th>Randy 54 mg</th>
<th>Jack 36 mg</th>
<th>Rick 36 mg</th>
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<td>1. Daydreams</td>
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<td>2.4 2.0</td>
<td>1.7</td>
<td>2.0 1.7</td>
<td>1.3</td>
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<td></td>
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</tr>
<tr>
<td>2. Talks less</td>
<td>1.6 2.0</td>
<td>1.7 1.8</td>
<td>3.6 3.2</td>
<td>2.0</td>
<td>2.0 2.3</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3. Uninterested</td>
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<td>2.1 1.4</td>
<td>3.6 3.8</td>
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</tr>
<tr>
<td>4. Appetite</td>
<td>n/a n/a</td>
<td>n/a n/a</td>
<td>n/a n/a</td>
<td>n/a n/a</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>5. Irritable</td>
<td>1.0 1.3</td>
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<td>2.6 2.1</td>
<td>2.1 1.3</td>
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<td>6. Stomachaches</td>
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</tr>
<tr>
<td>7. Headaches</td>
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<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Drowsiness</td>
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<td>0.9 0.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Sad/unhappy</td>
<td>0.6 0.4</td>
<td>3 2.1</td>
<td>1.9 1.6</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Cry/whine</td>
<td>1.4 1</td>
<td>3.9 2.8</td>
<td>2 1.6</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Anxious</td>
<td>2.1 0.7*</td>
<td>4 2.3</td>
<td>1.6 1.7</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Fingernails</td>
<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Euphoric</td>
<td>4.6 1.8**</td>
<td>2.5 1.3</td>
<td>3.1 1.7</td>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Dizziness</td>
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<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Tics</td>
<td>0.1 0</td>
<td>0.3 0.1</td>
<td>0.9 0.5</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Playful</td>
<td>5 5.92</td>
<td>6.4 7</td>
<td>3.4 3.8</td>
<td>4.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Play alone</td>
<td>4.8 2.8**</td>
<td>2.6 2.1</td>
<td>6.4 5.5</td>
<td>6.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Withdrawn</td>
<td>2.3 1.6</td>
<td>2.3 1.4</td>
<td>4.1 3.8</td>
<td>3.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Nail biting</td>
<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Skin pick</td>
<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p<0.05
** p<0.01
*** p<0.005
**** p<0.001

Pla = Placebo
Con = Concerta
**Child Rating Scale**

*Eric*. No significant medication effects were noted for any of the variables for Eric on the child rating scale (See Table 7).

*Brad*. While on his prescribed dose of Dexedrine, Brad indicated that he felt less nervous while taking medication (p<0.05). No other variables from the child rating scale were significant (See Table 7).

*Randy*. No significant medication effects were noted for any of the variables from the child rating scale (See Table 7).

*Ruby*. Given her communication difficulties (i.e., selective mutism), the child rating scale was not administered to Ruby.

*Jack*. No significant medication effects were noted for any of the variables from the child rating scale (See Table 7).

*Rick*. On the child rating scale, Rick reported that it was more difficult for him to have fun while receiving the placebo dose (p<0.05) (See Table 7).

**Summary**. Only two significant findings were reported with the child rating scale. Brad reported that he felt less nervous while taking Dexedrine. Nick reported that it was more difficult to have fun while on the placebo dose.
## Table 7. Child Rating Scale Results

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Eric 20 mg</th>
<th>Brad 20 mg</th>
<th>Randy 10 mg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pla</td>
<td>Add</td>
<td>Pla</td>
</tr>
<tr>
<td>1. Somatic complaints</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2. Talk to other kids</td>
<td>2.0</td>
<td>2.0</td>
<td>0.1</td>
</tr>
<tr>
<td>3. Pay attention</td>
<td>0.4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4. Stay quiet</td>
<td>0.7</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>5. Tired</td>
<td>0.7</td>
<td>0.5</td>
<td>1.4</td>
</tr>
<tr>
<td>6. Sad</td>
<td>0.7</td>
<td>0.3</td>
<td>0.1</td>
</tr>
<tr>
<td>7. Nervous</td>
<td>0.4</td>
<td>0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>8. Happy</td>
<td>1.9</td>
<td>1.8</td>
<td>2.0</td>
</tr>
<tr>
<td>9. Stay in your seat</td>
<td>0.4</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>10. Dizzy</td>
<td>1.1</td>
<td>0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>11. Play with friends</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>12. Easy to do work</td>
<td>1.9</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>13. Easy to be good</td>
<td>1.7</td>
<td>1.8</td>
<td>2.0</td>
</tr>
<tr>
<td>14. Slow</td>
<td>1.0</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>15. Hard to have fun</td>
<td>0.6</td>
<td>0.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

* p<0.05  ** p<0.01  *** p<0.005  **** p<0.001

Pla = Placebo  Add = Adderall  Dex = Dextedrine
<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Jack 36 mg</th>
<th>Jack 36 mg</th>
<th>Jack 54 mg</th>
<th>Rick Con</th>
<th>Rick Con</th>
<th>Rick Con</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pla</td>
<td>Con</td>
<td>Pla</td>
<td>Con</td>
<td>Con</td>
<td>Con</td>
</tr>
<tr>
<td>1. Somatic complaints</td>
<td>0.3</td>
<td>0</td>
<td>1.2</td>
<td>1.3</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>2. Talk to other kids</td>
<td>0.5</td>
<td>0.4</td>
<td>1.2</td>
<td>1.3</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>3. Pay attention</td>
<td>0</td>
<td>0.2</td>
<td>1.2</td>
<td>1.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>4. Stay quiet</td>
<td>0</td>
<td>0.2</td>
<td>1.2</td>
<td>1.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>5. Tired</td>
<td>0.2</td>
<td>0.2</td>
<td>1.6</td>
<td>1.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>6. Sad</td>
<td>0.2</td>
<td>0</td>
<td>0.8</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>7. Nervous</td>
<td>0</td>
<td>0.2</td>
<td>1.2</td>
<td>1.3</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>8. Happy</td>
<td>1.5</td>
<td>1.2</td>
<td>1.6</td>
<td>1.8</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>9. Stay in your seat</td>
<td>0.2</td>
<td>0</td>
<td>2.0</td>
<td>1.8</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>10. Dizzy</td>
<td>0</td>
<td>0</td>
<td>1.2</td>
<td>1.5</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>11. Play with friends</td>
<td>1.0</td>
<td>0.9</td>
<td>1.6</td>
<td>1.8</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>12. Easy to do work</td>
<td>0.3</td>
<td>0.7</td>
<td>1.6</td>
<td>1.2</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>13. Easy to be good</td>
<td>0.3</td>
<td>0.7</td>
<td>2.0</td>
<td>1.8</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>14. Slow</td>
<td>0.2</td>
<td>0</td>
<td>1.6</td>
<td>1.0</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>15. Hard to have fun</td>
<td>0.17</td>
<td>0.2</td>
<td>2.0</td>
<td>0.8*</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

* p<0.05
** p<0.01
*** p<0.005
**** p<0.001

Pla = Placebo
Con = Concerta
No other significant findings were reported by any of the participants.

Structured Child Interview

**Eric.** While taking medication, Eric reported that he did not like the way it made him feel. While receiving the placebo dose, Eric reported that he liked the way his medication made him feel.

**Brad.** While on Dexedrine, Brad reported that he would stop taking his medication if given the opportunity. Conversely, while on the placebo dose, Brad reported that he would not stop taking his medication if given the chance.

**Randy.** While on Concerta, Randy reported that he would stop taking his medication if given the opportunity.

**Ruby.** Given her communication difficulties (i.e., selective mutism), the child interview was not used with Ruby.

**Jack.** No significant medication effects were noted for any of the variables from the child interview.

**Rick.** No significant medication effects were noted for any of the variables from the child interview.

**Summary.** Similar to what was seen with the child rating scale, the children appeared to have difficulty answering questions regarding their medication effects
accurately during the structured interview. The only relatively consistent finding was that three of the children (Brad, Randy and Eric) reported that they did not like the way medication made them feel while they were taking their prescribed dose of stimulant medication.
CHAPTER 4: DISCUSSION

The purpose of the current investigation was to determine if stimulant medications alter play and related social behavior in preschool children diagnosed with ADHD. To evaluate these effects, a number of measurement techniques were employed, including direct observations of social behavior in a variety of different play conditions (recess, sports training, alone play and Tiger Camp observations), an evaluation of the reinforcing efficacy of play with a social reinforcer assessment and child and teacher rating scales/child interviews.

The findings from the recess observations illustrate the variability in medication response across participants. With the exception of Rick, relatively few significant findings were ascertained in the recess observations. Rick exhibited a number of pronounced medication effects while on the high dose of Concerta (54 mg), including decreased toy play, decreased solitary play, decreased activity level and increased levels of anxiety/stereotyped behavior.

There were some other idiosyncratic effects during the recess observations for two of the participants. Ruby exhibited a significant decrease in the number of social vocalizations while taking Adderall. Conversely, Adderall increased the occurrence of social vocalizations made
during the recess period for Eric. The fact that the exact opposite effects were observed on the same dependent measure for two different participants illustrates the high degree of variability in the individual response to stimulant medications.

The purpose of the sports training condition was to determine if stimulant medications have significant effects on social behavior during structured play settings. In this condition, stimulant medication significantly increased game participation for several of the participants while producing a corresponding increase in anxiety/stereotyped behavior. With the exception of one participant (Rick), the increase in anxiety/stereotyped behavior was observed specifically in the structured sports training setting and in neither unstructured play conditions (recess and alone conditions). Rick exhibited heightened levels of anxiety/stereotyped behavior, including lip picking and nail biting, in both the sports training and the unstructured recess conditions. Similar kinds of stimulant-induced stereotyped behaviors have previously been documented in humans and have been referred to as “punding” (Fernandez & Friedman, 1999; Schiorring, 1981). According to Schiorring (1981), punding includes motor stereotypy with repetitive, aimless activities involving various
objects, including one’s own body (e.g., hands and mouth). Given the status of the current literature, the improvements in game participation were expected and would generally be considered beneficial. Conversely, the effects of stimulant-induced anxiety/stereotyped behavior are unknown and present a new avenue for future research.

The purpose of the alone play condition was to evaluate the effects of stimulant medication on behavior in an unstructured, nonsocial play setting. Again, the findings from the alone play condition demonstrate the high variability in individual medication response. Two of the children exhibited minor decreases in locomotor activity (i.e., activity level and/or steps taken) while taking stimulant medication. This finding is consistent with previous research documenting stimulant-induced decreases in locomotor activity (Barkley & Cunningham, 1979a; Barkley & Cunningham, 1979b; Cunningham & Barkley, 1978; Handen, et al., 1995). Another participant exhibited a significant decrease in the occurrence of vocalizations while on stimulant medication.

The findings from the reinforcer assessment indicated that stimulant medication significantly altered the reinforcing value of specific types of play for several of the participants. Stimulant medication decreased the
reinforcing value of social play while increasing the value of solitary play (Rick) or quiet time (Brad) for two of the participants. Stimulant medication had the opposite effect for another participant (Eric). For this participant, social play appeared to increase in value while on stimulant medication. As had been observed in the direct observations, the findings from the reinforcer assessment indicate that the social effects of stimulant medication can vary significantly across individuals.

The rating scales and child interview were designed to determine if indirect measures were useful for detecting social side effects and if these measures correlated well with direct observations. The measures used in this evaluation included a teacher rating scale, a child rating scale and a structured child interview. Overall, the data from the rating scales and interview did not correlate well with direct observations or the social reinforcer assessment. The child exhibiting the most pronounced side effects in direct observations (i.e., Rick) had no significant behavioral side effects indicated on any of the variables from the teacher rating scale. Another participant (i.e., Ruby) was reported to have a number of social side effects that were not observed in the direct observations.
Additionally, the participants from the study were unable to reliably report their own side effects with the daily child rating scale and a structured interview. It is possible that preschool children are too young to accurately report how medication makes them feel.

The present findings show that stimulants can have detrimental effects in some children. The prevailing opinion is that stimulant medications either have no significant detrimental effects on social behavior (Dulcan & Benson, 1997; Hinshaw, 1991; MTA Cooperative Group, 2000; NIH Consensus Statement, 1998), or improve it (Granger, Whalen & Henker, 1993; Smith, et al., 1998; Pelham, Greenslade, Vodde-Hamilton, Murphy, Greenstein, Gnagy, Guthrie, Hoover & Dahl 1990, Klein, 1993). One possible reason for this apparent contradiction is that some observers may mistakenly perceive the absence of disruptive behavior as an improvement in adaptive behavior. As is done with other disorders (e.g., schizophrenia), it is possible to conceptualize the symptoms of ADHD as being either positive or negative. Positive symptoms are undesired behaviors, such as inappropriate vocalizations or out-of-seat behavior in the classroom. As reviewed previously, stimulants have been shown to be quite effective for reducing the occurrence of such symptoms (Greenhill,
Halperin & Abikoff, 1999; Pelham, 1993). Negative symptoms are behaviors that are desired, yet deficient, such as academic achievement and prosocial behavior. Stimulants have not been shown to be effective for improving the negative symptoms associated with ADHD (i.e., Rie et al., 1975). A possible explanation for conflicting views about the efficacy of stimulants in improving social behaviors in ADHD is that they reduce positive symptoms by decreasing social interaction and play.

The results from the current study illustrate the high degree of individual variability in medication response across participants. Medication had a number of detrimental social effects in some participants while other children displayed improvements in social behavior (i.e., social interaction). These findings demonstrate the utility of single subject research for clinical medication evaluation.

Another important contribution from the current study was the finding that stimulant medication can significantly alter the reinforcing efficacy of social play. Stimulant medication decreased the value of social play for some children, while it increased its value for another. These findings are of particular importance given that they illustrate how stimulants influence the motivation to engage in particular activities, including social play. The
implications of these results are that stimulant medications can significantly affect the reinforcing properties of certain items and/or activities, which can therefore influence the effectiveness of behavioral interventions.

Another important finding from the current study was the lack of correspondence between direct observations and the results from the rating scales and child interview. Given that most medication changes are based on anecdotal report and/or rating scale data, this lack of agreement is of great significance. The results from this investigation, specifically the teacher rating scale, raise a number of questions regarding the validity of rating scales. There is a need for research investigating the characteristics that make side effects for some children more likely to be noticed than in others. It is possible that side effect detection varies as a function of time spent with the child. It is also likely that children who are disruptive tend to be observed more closely by teachers and parents.

The current investigation presented some unique methods for assessing the value of social play in children. Direct observations, although logically appealing, are rarely used in the context of medication assessments. The observation procedures used in this investigation may
provide researchers with a useful resource for assessing the social effects of psychotropic medication.

Additionally, the social reinforcer assessment presented a unique way to evaluate the effects of psychotropic medication on the value of social reinforcers. The reinforcer assessment provided useful insight regarding the effects of these medications and required very little time to conduct. The results from the current study demonstrate that reinforcer assessments can be used as an effective medication assessment tool.

The current study was also unique in that it included a number of supplemental self-report measures. There has been little research investigating the use of such measures in young children. Although the reliability of child self-report was questionable in the current study, it indicated that it is an area that requires further investigation.

Limitations in the Current Study

There were a number of limitations in the current investigation. The first of which was the limited number of dose conditions for each participant in the study. With the exception of Rick, only two dose conditions were used for each child (i.e., placebo and one drug dose). A greater number of significant social effects may have been observed had higher doses been used for some of the participants.
Several of the children in the current study were prescribed relatively low doses of stimulant medication.

Another limitation in the current study was the difficulty having an equal number of observations for each medication condition. Due to absences, clinical necessity and time constraints, it was not possible to have an equal number of observations for each medication condition.

Another constraining factor in this investigation was the limited amount of reinforcers (i.e., coupons) available during the reinforcer assessment. The coupons used in the current assessment were redeemable for 2 minutes of the preferred activity (social play, alone play or quiet time). Due to time constraints during the day, the total number of coupons that could be redeemed was limited. Due to this ceiling effect, the sensitivity of the assessment may have been limited.

**Future Directions**

The current investigation indicates that there are a number of areas in need of further research. First, there is a need to place greater emphasis on the inclusion and measurement of play and social behaviors in future evaluations of stimulant medication effects. The majority of previous research has emphasized the effects of stimulant drugs on maladaptive behavior. Effects on
adaptive, particularly prosocial behavior and play, need to be studied as well. This is particularly important considering the central role that such behavior is assumed to play in normal development.

Second, there is a need for the development of objective medication evaluation procedures that can be used in a wide variety of settings. As has been previously discussed, medication evaluation procedures are frequently limited to anecdotal report and rating scales. A number of basic behavioral methodologies, such as direct observation, functional analyses and reinforcer assessments, may provide researchers with useful tools for the objective evaluation of medication effects (Fisher, Piazza, Bowman, Hagopian, Owens & Slevin, 1992; Iwata; Dorsey, Slifer, Bauman & Richman, 1994; Northup, et al., 1996).

Third, there is a need for pharmacological research with young children. As discussed previously, there is a considerable amount of literature indicating that the adverse social effects of stimulant drugs occur at an especially high rate in young children (Firestone, et al., 1996; Northup, in press; Schliefer, et al., 1975). Given this and the fact that use of stimulant drugs in this population is off label (stimulants have been approved for use in children aged 7 or older), use of stimulants in
preschool children is becoming a central issue. Also needed are more studies of the long-term efficacy and side effects from the use of these medications.

Summary and Conclusions

It is widely accepted as axiomatic that play and social interaction are important to normal childhood development. The present study highlights a number of potentially useful techniques for assessing the social effects of stimulants in children. Although numerous studies have evaluated the social effects of stimulant medication, in many of these studies social behavior and play have been peripheral considerations, and therefore not studied thoroughly, systematically, and with methodologic rigor. Second, the clinical literature suggests that the behavioral effects of stimulants, including those on social behavior and play, are highly idiosyncratic (Handen, et al., 1995, Northup, et al., in press; Rapaport, et al., 1994; Whalen, Henker, Swanson, Granger, Kliewer & Spencer, 1987). Reliance on group designs, which is the norm in psychopharmacology research, as opposed to single subject designs, tends to obscure such individual differences. Third, there has been an over-reliance on rating scales and “clinical impressions” for determining the presence of the adverse effects of psychotropic medications. Although
useful, rating scales have a number of limitations for the evaluation social and play behaviors. In addition to rater bias and possible halo effects, most current rating scales focus almost exclusively on the core symptoms of ADHD (i.e., attention, hyperactivity and impulsivity) and/or disruptive classroom behavior rather than social behavior. It is noteworthy that the most commonly used rating scale for ADHD has only one question that is generally related to social behavior.

In conclusion, stimulants are now being administered to children on an unprecedented scale. Although serious problems affecting high percentages of children have not been detected despite decades of use, medical history has shown, sometimes tragically (e.g., in the case of thalidomide), that drugs can have hidden dangers. Given the vulnerability of the principal patient population and the scale on which these drugs are being used, any hint of risk should be given serious consideration.
CHAPTER 5: REFERENCES


## APPENDIX A – CHILD RATING SCALE

<table>
<thead>
<tr>
<th>Side Effect Rating Scale</th>
<th>Not at all</th>
<th>Little bit</th>
<th>Some</th>
<th>A lot</th>
<th>All the time</th>
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</thead>
<tbody>
<tr>
<td><strong>Child Form</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. My head/stomach hurts today (or any other somatic complaints).</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I didn’t feel like talking to other kids today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. It was hard to pay attention today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I had a hard time staying quiet today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. I feel tired today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. I feel sad today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. I feel nervous today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. I feel happy today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. It was hard to stay in my seat today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. I feel dizzy today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. Playing with friends was fun today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. It was easy to do my work today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. It was easy to be good today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. I felt slow today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. It was hard to have fun today</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
### APPENDIX B - TEACHER RATING SCALE

#### Side Effects Rating Scale

**Recess Monitor/Teacher Version**

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Absent</th>
<th>Serious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stares a lot or daydreams</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Talks less with others</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Uninterested in others</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Decreased appetite</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Irritable</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Stomachaches</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Headaches</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Drowsiness</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Sad/unhappy</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Prone to crying/whining</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Anxious</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Bites fingernails</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Euphoric/unusually happy</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Dizziness</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Tics or nervous movements</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Playful with others</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Played alone</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Socially withdrawn</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Nail biting</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
<tr>
<td>Skin picking</td>
<td>0  1  2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C - STRUCTURED CHILD INTERVIEW

Date:

Participant:

Medication Dose:

1. Do you normally take medication?

2. What is it called?

3. Why are you taking ________?

4. Do you like taking ________?

5. What is ________ supposed do for you?

6. Does ________ help you...
   a. pay attention to the teacher? YES NO
   b. stay clam? YES NO
   c. remain in your seat? YES NO
   d. keep from fighting? YES NO
   e. to be nice? YES NO
   f. to walk rather than run? YES NO
   g. to be patient? YES NO
   h. Get along with your friends? YES NO
7. When you take __________, is there anything you dislike about the way it makes you feel?

8. Does __________ make you smarter?

9. Does __________ make it harder for you the have fun with friends or toys?

10. Does __________ ever make you feel sick?

11. If you could stop taking __________, would you?

12. What would happen if you stopped taking __________?

13. Do your friends know that you take __________?

14. Do you care if they know that you take __________?

15. Do you know what Attention Deficit Hyperactivity Disorder is? What is it? Do you have it?
APPENDIX D – UNSTRUCTURED RECESS GRAPHS

Figure 1. Percent of intervals with toy play
Figure 2. Percent of intervals with social play
Figure 3. Percent of intervals with solitary play
Figure 4. Percent of intervals with social vocalizations
Figure 5. Percent of intervals with nonsocial vocalizations
Figure 6. Percent of intervals activity level
Figure 7. Percent of intervals with anxiety/stereotyped behavior
Figure 8. Percent of intervals with escape attempts
Figure 9. Percent of intervals with social withdrawal
Figure 10. Number of steps taken
Figure 1. Percent of intervals with toy play. A significant decrease was observed for Rick at the 54 mg Concerta dose (p<0.001). A significant increase in toy play was observed for Randy (p<0.05).
Figure 2. Percent of intervals with social play. No significant medication effects were observed for social play.
Figure 3. Percent of intervals with solitary play. A significant decrease in solitary play was observed for Rick while on the 54 mg dose of Concerta.
Figure 4. Percent of intervals with social vocalizations. A significant increase in the number of intervals with social vocalizations was observed for Eric at the 20 mg Adderall dose (p<0.01). A significant decrease in social interactions was observed for Ruby while on 20 mg of Adderall (p<0.001)
Figure 5. Percent of intervals with nonsocial vocalizations. No significant medication effects were observed for nonsocial vocalizations.
Figure 6. Percent of intervals with high activity. A significant decrease in activity level was observed for Rick at the 54 mg Concerta dose (p<0.001).
Figure 7. Percent of intervals with anxiety/stereotyped behaviors. A significant increase in anxiety/stereotyped behaviors was observed for Rick at the 54 mg Concerta dose (p<0.001).
Figure 8. Percent of intervals with escape attempts. A significant decrease in escape attempts was observed for Rick at both the 36 mg and 54 mg Concerta dose (p<0.05).
Figure 9. Percent of intervals with social withdrawal. No significant effects were observed for social withdrawal.
Figure 10. Number of steps taken. No significant medication effects were observed for the number of steps taken.
APPENDIX E – STRUCTURED SPORTS TRAINING GRAPHS

Figure 1. Percent of intervals with game participation
Figure 2. Percent of intervals with social vocalizations
Figure 3. Percent of intervals with nonsocial vocalizations
Figure 4. Percent of intervals with high activity level
Figure 5. Percent of intervals with anxiety/ stereotyped behavior
Figure 6. Percent of intervals with escape attempts
Figure 7. Number of steps taken
Figure 1. Percent of intervals with game participation. Significant increases in game participation were observed for Eric (p<0.05), Brad (p<0.001), Randy (p<0.05) and Rick (both doses: 36 mg Concerta p<0.005; 56 mg Concerta p<0.001).
Figure 2. Percent of intervals with social vocalizations. A significant decrease in social vocalizations was observed for Rick at both the 36 mg the 54 mg Concerta dose ($p<0.05$ and $p<0.01$, respectively).
Figure 3. Percent of intervals with nonsocial vocalizations. No significant medication effects for nonsocial vocalizations were observed.
Figure 4. Percent of intervals with high activity. A significant decrease in activity level was observed for Brad at the 20 mg Dexedrine dose (p<0.01).
Figure 5. Percent of intervals with anxiety/stereotyped behaviors. A significant increase in anxiety/stereotyped behavior was observed for Brad (p<0.005), Randy (p<0.05) and Rick at both the 36 mg and 54 mg dose of Concerta (p<0.05 and p<0.001, respectively). The apparent increase in anxiety/stereotyped behaviors for Eric did not achieve statistical significance (p=0.06).
Figure 6. Percent of intervals with escape attempts. A significant decrease in escape attempts was observed for Randy at the 54 mg Concerta dose (p<0.05).
Figure 7. Number of steps taken. A significant decrease in the number of steps taken was observed for Brad at the 20 mg Dexedrine dose (p<0.005).
APPENDIX F – ALONE PLAY GRAPHS

Figure 1. Percent of intervals with toy play
Figure 2. Percent of intervals with vocalizations
Figure 3. Percent of intervals with activity level
Figure 4. Percent of intervals with anxiety/stereotyped behavior
Figure 5. Percent of intervals with escape attempts
Figure 6. Percent of intervals with steps taken
Figure 1. Percent of intervals with toy play. No significant medication effects on toy play were observed.
Figure 2. Percent of intervals with vocalizations. A significant decrease in vocalizations was observed for Brad at the 20 mg Dexedrine dose (p<0.01).
Figure 3. Percent of intervals with high activity. A significant decrease in activity level was observed for Eric at the 20 mg Adderall dose (p<0.05).
Figure 4. Percent of intervals with anxiety/stereotyped behaviors. No significant medication effects were observed for anxiety/stereotyped behavior.
Figure 5. Percent of intervals with escape attempts. No significant medication effects were observed.
Figure 6. Number of steps taken. A significant decrease in the number of steps taken was observed for Eric on the 20 mg Adderall dose (p<0.05) and at the 20 mg Dexedrine dose (p<0.05).
APPENDIX G – TIGER CAMP OBSERVATION GRAPHS

Figure 1. Percent of intervals with game participation
Figure 2. Percent of intervals with social vocalizations
Figure 3. Percent of intervals with nonsocial vocalizations
Figure 4. Percent of intervals with activity level
Figure 5. Percent of intervals with anxiety/ stereotyped behavior
Figure 6. Percent of intervals with escape attempts
Figure 7. Percent of intervals with social withdrawal
Figure 1. Percent of intervals with game participation. An increase in game participation was observed for Randy while taking the 54 mg Concerta dose.
Figure 2. Percent of intervals with social vocalizations. No significant medication effects were observed for social vocalizations.
Figure 3. Percent of intervals with nonsocial vocalizations. No significant medication effects were observed for nonsocial vocalizations.
Figure 4. Percent of intervals with high activity. No significant medication effects for activity level were observed.
Figure 5. Percent of intervals with anxiety/stereotyped behavior. An increase in anxiety/stereotyped behavior was observed for Randy at the 54 mg Concerta dose.
Figure 6. Percent of intervals with escape attempts. No significant effects were observed for escape attempts.
Figure 7. Percent of intervals with social withdrawal. No significant medication effects for social withdrawal were observed.
APPENDIX H – SOCIAL REINFORCER ASSESSMENT GRAPHS

Figure 1. Coupons selected while on placebo dose
Figure 2. Coupons selected while on low dose of stimulant medication
Figure 3. Coupons selected on the high dose of stimulant medication
Figure 4. Total coupons selected
Figure 5. Percent of coupons selected
Figure 1. Coupons selected while on placebo dose. These are cumulative graphs depicting the number of each kind of coupon selected while on the placebo dose. The data show that the children mainly selected peer play coupons while on placebo.
Figure 2. Number of coupons selected while on the low dose of stimulant medication. This is a cumulative graph depicting the number of each kind of coupon selected by Rick while on the low dose of stimulant medication (36 mg of Concerta). The data show that the Rick mainly selected peer play coupons while on the low dose of Concerta.
Figure 3. Number of coupons selected while on the high dose of stimulant medication. This is a cumulative graph depicting the number of each kind of coupon selected by the participants while on the high dose of stimulant medication. The data show that two of the participants selected alone play coupons more frequently while on the high dose of stimulant medication.
Figure 4. Total number of blocks placed in the bucket. No significant medication effects were observed for the total number of blocks placed in the bucket.
Figure 5. Percent of coupons selected. These graphs show that both Brad and Rick selected a higher percentage of nonsocial coupons (i.e., alone play and quiet time coupons) while on the high dose of stimulant medication. The opposite effect was observed for Eric. Eric selected a higher percentage of peer play coupons while on the high dose of stimulant medication.
Vita

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