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# The Effect of Covert Audio Coaching on the Attending Behavior of Elementary Students with Autism Spectrum Disorder in the Classroom Setting

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FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida

THE EFFECT OF COVERT AUDIO COACHING ON THE ATTENDING BEHAVIOR  
OF ELEMENTARY STUDENTS WITH AUTISM SPECTRUM DISORDER IN THE  
CLASSROOM SETTING

A dissertation submitted in partial fulfillment of the

requirements for the degree of

DOCTOR OF EDUCATION

in

EXCEPTIONAL STUDENT EDUCATION

by

Christina Crocco

2017

To: Dean Michael R. Heithaus  
College of Arts, Sciences, and Education

This dissertation, written by Christina Crocco, and entitled *The Effect of Covert Audio Coaching on the Attending Behavior of Elementary Students with Autism Spectrum Disorder in the Classroom Setting*, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this dissertation and recommend that it be approved.

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Date of Defense: June 16, 2017

The dissertation of Christina Crocco is approved.

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Dean Michael R. Heithaus  
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Andres G. Gil  
Vice President for Research and Economic Development  
and Dean of the University Graduate School

Florida International University, 2017

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## DEDICATION

This dissertation is dedicated to Kaleb. Thank you for inspiring me to learn more about children with autism.

## ACKNOWLEDGMENTS

I would like to thank the members of my committee for their dedication, time, and assistance in completing this dissertation. I would especially like to thank my major professor, Kyle D. Bennett, without whom this study would not have been possible. Your guidance, patience, and expertise made this dissertation and my doctoral experience immensely rewarding. Also, thank you to Enas for being my data collector and assisting me with the implementation of this study.

ABSTRACT OF THE DISSERTATION  
THE EFFECT OF COVERT AUDIO COACHING ON THE ATTENDING BEHAVIOR  
OF ELEMENTARY STUDENTS WITH AUTISM SPECTRUM DISORDER IN THE  
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by

Christina Crocco

Florida International University, 2017

Miami, Florida

Professor Kyle D. Bennett, Major Professor

Autism Spectrum Disorder (ASD) is the fastest growing disability category in U.S. schools. Current legislation mandates that students with disabilities be educated in the classroom setting to the greatest extent possible. The increase in prevalence combined with placement regulations presents a challenge for classroom teachers who support students with ASD, as many of these students struggle with the necessary classroom skills to function appropriately in that environment. Classroom skills have been referred to in the literature as skills that are required for learning to occur, including: (a) looking at the teacher, (b) keeping hands to self, (c) raising a hand before talking, and (d) completing appropriate academic tasks. This study will focus on the classroom skill of attending.

Since ASD is a spectrum, an intervention that is effective for one individual may not be successful for another, despite having the same diagnosis. Applied Behavior Analysis (ABA) is a discipline that is among the most effective, scientifically-based methods, for educating children with ASD. Covert audio coaching (CAC) is an

intervention that adheres to the principles of ABA. Covert audio coaching is a form of performance feedback that involves an instructor coaching a participant from a distance. Both have a two-way radio, and the participant wears an earpiece so that they can receive feedback from the coach without anyone except the participant knowing they are being supported. While CAC has been used successfully to support individuals with disabilities throughout the past several years, there is only one published study that explored the effectiveness of CAC with its use on an elementary school student with a disability.

The current study examined the effect of CAC on the classroom skill of attending of four elementary school students with ASD in their classrooms. The researcher provided supportive and corrective statements to participants via an earpiece device during instructional time. A multiple probe design across participants was used. A visual analysis showed that the CAC intervention was successful for all four participants, with increased levels of attending maintaining for up to five weeks once the intervention was removed.

The results of this study suggest that CAC can be an effective intervention for improving the classroom skills of children with ASD in the classroom setting.



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# CHAPTER I

## INTRODUCTION

Autism Spectrum Disorder (ASD) is on the rise in the United States (Centers for Disease Control [CDC], 2015). First identified in 1943 by Leo Kanner, ASD has become increasingly prevalent in recent decades. So much so that the CDC now considers it to be a significant health concern (2015), and is continuously working to better define and understand the disorder. The classification of ASD has been revised numerous times, as recently as 2013, in an attempt to make diagnoses more specific and consistent (CDC, 2013). Yet despite these efforts, this disability is still widely misunderstood.

With the increase in prevalence has come an increase in awareness and research. But while experts in fields such as medicine and psychology are researching potential causes and cures, there are individuals who require immediate support. Since a cure to ASD has not been discovered, there are individuals of all ages who are affected by it. Of special concern to the education system are the children living with ASD.

According to the most recent report by the CDC published in 2013, ASD affects 1 in 68 children in the United States and is five times more common among boys (1 in 42) than girls (1 in 189). Autism Spectrum Disorder is a developmental disability that can cause communication, social, and behavioral challenges (CDC, 2013). It is a spectrum disorder, and therefore, individuals with the disability experience different challenges to varying degrees. Some individuals with ASD are verbal, attend college, and maintain employment in their adult years, while others are nonverbal, have significantly low IQs, and live in homes for individuals with disabilities as adults (Gray et al., 2014). While individuals on the autism spectrum vary in their social, communicative, and behavioral

needs, socialization deficits remain a primary source of impairment regardless of cognitive or language ability (Carter, Davis, Klin, & Volkmar, 2005). Autism Spectrum Disorder is a life-long disorder, and current treatment involves therapies that can improve functioning but not completely eliminate the effects of the disorder (Bryson, 1996; Hill & Frith, 2003). The fact that there is no cure for ASD means that it poses significant challenges to not only the affected individuals but also the educational system that supports them as students (Samson et al., 2014).

### **Educational Placement of Students with Autism Spectrum Disorder**

The increase in prevalence of ASD combined with the absence of a cure presents a challenge for teachers, as they must find ways to meet the unique needs of their students with ASD. According to the 2015 Annual Report to Congress (U.S. Department of Education [USDOE]), 513,688 students with ASD, ages six through 21, were served under the Individuals with Disabilities Education Improvement Act (IDEIA), as compared to 193,657 in 2005. These data indicate that the population of children with ASD is growing. With more students than ever before having an ASD diagnosis, there is a pressing need for educational supports for this population regardless of educational placement (Hayes et al., 2004; Shattuck, 2006).

The concept of Least Restrictive Environment (LRE) for students with disabilities was first introduced in 1975 as part of Public Law 94-142, the Education for All Handicapped Children Act (Baglieri & Shapiro, 2012; Crockett & Kaufmann, 2013; Martin, Martin, & Terman, 1996; McLeskey, Landers, Williamson, & Hoppey, 2012). Subsequently renamed IDEIA, the legislation requires that students with disabilities must

have the opportunity to be educated alongside typical peers to the greatest extent possible, in the LRE (IDEIA, 2004).

Since ASD is a spectrum with heterogeneity among children with the same diagnosis, the LRE for students with ASD may be the general education classroom depending on the severity of their behaviors and their academic needs (IDEIA, 2004).

The educational practice of students with ASD and other disabilities being taught in the general education classroom with their typical peers is referred to as inclusion (Rodriguez & Garro-Gil, 2015). Supporters of inclusion believe it to be a civil rights issue that aims to eliminate social exclusion as a consequence of ability, among other differences (Lalvani, 2013; Vitello & Mithaug, 1998). Although the term inclusion is not specifically mentioned in any of the revised versions of IDEIA, the law mandates that all children be educated in their LRE, which, depending on their individual needs, may mean the general education classroom, or any other setting along the continuum of services to include separate schools or hospital/homebound settings (IDEIA, 2004).

Teachers are often the primary intervention agent (Koegel, Matos-Fredeen, Lang, & Koegel, 2011) when students with ASD are in the classroom, meaning teachers must not only be knowledgeable about interventions but also make time to accommodate students. Research shows, however, that despite the increase in awareness of individuals with ASD, the disability continues to be an “intriguing mystery” (Simpson, de Boer-Ott, & Smith-Myles, 2003, p. 116) to professionals. Regardless of their level of familiarity with the disorder, teachers of students with ASD must find ways to meet their unique needs.

Children without disabilities tend to inherently understand the nuances of a classroom, but children with ASD often miss many social cues because of their disability (Centelles, Assaiante, Etchegoyhen, Bouvard, & Schmitz, 2013; Chevallier, Huguet, Happé, Geiroge, & Conty, 2013; Gresham, 1984; Müller, Schuler, & Yates, 2008; Mandelberg et al., 2014; Rao, Beidel, & Murray, 2008). While the majority of children do not require explicit instruction or coaching to navigate the multitude of demands of the classroom, children with ASD may need this kind of assistance (Chevallier et al., 2013; Hutchins et al., 2016; Vernon, 2014; Williams, Minshew, & Goldstein, 2015; Wilson, 2013).

Several strategies have been documented as being useful for supporting students with ASD in the classroom setting. They involve both environmental modifications, such as pairing students with typical, friendly peers for group activities (McCurdy & Cole, 2014), and routine supports such as providing students with visual schedules to use throughout the day (Hirano et al., 2010). Simpson and colleagues (2003) found that children with ASD generally do not have the necessary social skills to assimilate in the classroom setting. In a review of effective strategies for including children with ASD in classrooms, Harrower and Dunlap (2001) found that peer-mediated interventions, self-management strategies, and antecedent procedures have been successful in accommodating children with ASD in terms of their social needs.

The focus on social skills and acceptance by peers is consistent throughout the literature as being a key focus of the inclusion of children with ASD. As a consequence of the wide range of cognitive and behavioral functioning among children with ASD, a need for social support is common among the majority of children with the disorder.

Thus, the ASD population must be supported in the classroom, not just academically, but socially as well (Escobedo et al., 2012; Gantman, Kapp, Orenski, & Laugeson, 2012; Kasari, Rotheram-Fuller, Locke, & Gulsrud, 2012).

Even though children with ASD may be in the general education setting for a portion or the majority of their school day, simply placing them amongst their typical peers may not be enough for them to acquire appropriate social behaviors. As indicated above, placement is not sufficient because children with ASD typically do not respond to social cues like their peers without disabilities (Centelles et al., 2013; Chevallier et al., 2013; Gresham, 1984; Müller et al., 2008; Mandelberg et al., 2014; Rao et al., 2008). While typically developing children may automatically imitate and learn from subtle environmental contingencies, children with ASD are not likely to do so.

When compared to children without disabilities, the notion of not imitating the behavior of others is particularly problematic for children with ASD, as impaired social skills are a core deficit of the disorder (American Psychiatric Association [APA], 2013). Individuals with ASD tend to demonstrate persistent deficits in social communication and social interaction across multiple contexts (APA, 2013), which is difficult in the context of a classroom since social interaction occurs throughout the day between students and teachers. Diminished social attention to events and individuals is also a common trait among the ASD population (Ashwin, Hietanen, & Baron-Cohen, 2015; Chevallier et al., 2015; Gharib, Mier, Adolphs, & Shimojo, 2015; Leboyer & Chaste, 2015; Shire et al., 2015). Additionally, diagnostic criteria for ASD includes deficits in nonverbal communicative behaviors used for social interaction such as difficulty understanding and using gestures and challenges adjusting behavior to suit various social contexts (APA,

2013). All of these consequences of ASD present challenges in functioning in a classroom setting.

### **Interventions for Classroom Skills**

The classroom environment provides opportunities for students to demonstrate various skills through interactions with teachers and peers. Opportunities for interaction have important implications for students with ASD as they often struggle with social skills, particularly skills related to engaging in conversation and playing with peers (Flynn & Healy, 2012; Locke, Kasari, & Wood, 2014; Reichow, Steiner, & Volkmar, 2013; Tonge, Rodebaugh, Fernandez, & Lim, 2016). Interventions that have been used to address these social skills deficits in children with ASD in the classroom setting include social skills groups (e.g., Kamps et al., 1992), social stories (e.g., Barry & Burlew, 2004), isolated play skills (e.g., Terpstra, Higgins, & Pierce, 2002), script training (Wichnick, Vener, Keating, & Poulson, 2010), peer models (Ledford & Wolery, 2013), peer tutoring (e.g., Kamps, Barbetta, Leonard, & Delquadri, 1994; Laushey & Heflin, 2000), video modeling (e.g., Cihak, Fahrenkrog, Ayres, & Smith, 2010; Delano, 2007), and activity schedules (e.g., Massey & Wheeler, 2000).

Like social skills, certain classroom skills are necessary for students to benefit from both educational and social practices that occur in the classroom setting. Classroom skills, according to Koegel and Rincover (1974) refer to “certain behaviors that seem necessary for learning to take place in a classroom” (p. 46). Specific classroom skills include attending, waiting, listening, and understanding nonverbal signals from teachers and peers (Bonar, 2015). Some research suggests that inadequate classroom skills of children with ASD stem from the social skills deficit inherent in their disability (Merrell



& Gimpel, 2014). Studies have examined this relationship and have highlighted the difficulties children with ASD have in demonstrating classroom skills such as those previously listed (Ducharme & Shecter, 2011; Kharbanda & Gupta, 2014; Zamora, 2013). Interventions that have been conducted to improve the classroom skills of students with ASD include peer modeling (Carter, Asmus, & Moss, 2014; Egel, Richman, & Koegel, 1981), environmental modifications (Barg, Carlson, & Moser, 2013), self-monitoring (Holifield, Goodman, Hazelkorn, & Heflin, 2010), and video self-modeling (Marcus, 2014). While the aforementioned procedures that target the classroom skills of students with ASD continue to be investigated, there is the possibility that other strategies, such as audio coaching and performance feedback used with other populations, could be effective at teaching such skills.

### **Covert Audio Coaching**

Covert audio coaching (CAC), also referred to as bug in ear (BIE) coaching, has been used to improve the performance of psychology interns (Korner & Brown, 1952); teachers (Giebelhaus 1994; Goodman, Brady, Duffy, Scott, & Pollard, 2008; Lindell, 2001; Ottley & Hanline, 2014; Scheeler, Congdon, & Stansbury, 2010; Scheeler & Lee, 2002; Scheeler, McAfee, Ruhl, & Lee, 2006); and parents (Oliver & Brady, 2014), and has supported employees with disabilities (Allen, Burke, Howard, Wallace, & Bowen, 2012; Bennett, Brady, Scott, Dukes, & Frain, 2010; Bennett, Ramasamy, & Honsberger, 2013a, 2013b). CAC is a form of coaching and performance feedback that involves an instructor and a participant communicating from a distance. The instructor and the participant who is receiving support each have a two-way radio, and the participant wears an earpiece. Using the two-way radio, the instructor can deliver feedback to the

participant in real time, from a distance, without anyone except the participant knowing that they are being supported. The covertness of CAC is a result of the size of the earpiece itself and the distance from which the instructor can be from the participant while still delivering real-time feedback. Thus, it is a discreet method that can be used to improve the behaviors of individuals in need.

With the advancement of technology in the last decade, CAC no longer requires large pieces of equipment. Now, CAC can be delivered via a small Bluetooth earpiece that is connected to a cellphone. Modern technology allows CAC to be done even more discreetly than earlier technology allowed it to be. Technological devices like tablets and cellphones are so common in schools (Martin & Ertzberger, 2013) that individuals with disabilities can be supported without having to worry about being stigmatized. In the past, assistive technology devices such as picture exchange books and augmentative communication devices tended to be bulky and were used primarily for people with disabilities. Thus, the discreet nature of CAC is perhaps the most unique part about this kind of intervention. While other interventions may require supports to be delivered in person or with outsiders witnessing, CAC allows for support to be provided in relative privacy.

Behavioral tactics that can be used in CAC include prompting, praise, guidance, and corrective statements. Depending on the design of the study and the skills being targeted, the researcher can determine which tactics will be used. Since the intervention includes technology, it is feasible to implement, remove, monitor, and reintroduce in terms of having the technology present or absent (Ayres, Mechling, & Sansosti, 2013; Bennett et al., 2010). The one-on-one aspect of CAC allows the instructor to have direct

communication with the individual being supported; therefore, not being directly interrupted during communication, unless the technology fails.

While there has been an increase in published research using CAC with individuals with disabilities throughout the last two decades (e.g., Allen et al., 2012; Bennett, 2013; Bennett et al., 2010; Bennett et al., 2013a, 2013b; Price, Martella, Marchand-Martella, & Cleanthous, 2002; Scheeler, MacLuckie, & Albright, 2010), none of these studies were done with students with ASD in a classroom setting. Currently, only one published study used CAC with a child with a disability in the classroom setting (i.e., Price et al., 2002). Price et al. (2002) used CAC to decrease inappropriate verbalizations of a 10-year-old boy with ADHD in his classroom. A researcher delivered prompting and reinforcement statements via the boy's earpiece during sessions and compared those results to sessions where the participant had received delayed feedback on his behavior. Results of this study showed that the CAC intervention was more successful in modifying the behavior of the participant than was the delayed feedback.

Existing research shows that CAC as an intervention can yield successful results in various settings, with students of different ages and abilities, to address various skills. Most notably, Price et al. (2002) demonstrated that CAC can be used in the classroom setting with a student with a disability. For these reasons, CAC should continue to be explored as a classroom skills intervention for students with ASD.

### **Statement of the Problem**

Students with ASD will likely not have the necessary social skills in their repertoire to function like their typical peers (Weiss & Harris, 2001). Effective interventions are needed to explicitly teach classroom skills to students with ASD who

struggle in the classroom setting. There are a few research-based practices for doing so, and a lack of research on the effectiveness of CAC for this purpose.

Covert audio coaching has been used to assist pre-service professionals (Baum & Lane, 1976; Korner & Brown, 1952), adolescents and adults with disabilities (Allen et al., 2012; Bennett, 2013; Bennett et al., 2010; Bennett et al., 2013a, 2013b), teachers (Giebelhaus, 1994; Goodman et al., 2008; Lindell, 2001; Ottley & Hanline, 2014; Scheeler & Lee, 2002; Scheeler et al., 2006; Scheeler et al., 2010), and parents (Oliver & Brady, 2014). Few studies, however, have used CAC with children with disabilities (c.f., Scheeler et al., 2010), and only one has been conducted in an elementary school classroom (i.e., Price et al., 2002). Currently no published studies used CAC with students with ASD in the classroom setting. The current study sought to expand the existing literature on the use of CAC with individuals with disabilities by exploring its use with children with ASD in the classroom setting.

### **Theoretical Framework**

The present study is grounded in Skinner's philosophy of radical behaviorism (1953). Through his research on animals, Skinner discovered that behavior is both shaped and maintained by reinforcing consequences (1953). His research focused on the relationship between observable stimuli and responses, which lead him to conclude that behavior, in part, is influenced by its consequences (Skinner, 1953). Learning in this manner is understood to be the way people learn in everyday life, as it occurs naturally while individuals engage in voluntary actions (Pierce & Cheney, 2013). Behaviorism also posits that consequences of behavior will affect the future occurrence of that behavior under the same or similar conditions. This belief means that whatever happens after we

engage in a behavior will impact whether we engage in that same behavior again when faced with a similar situation.

The concept that consequences influence future actions has since turned into a discipline for modifying the behavior of individuals with behavioral needs, such as those with ASD. This discipline is referred to as applied behavior analysis (ABA), which involves focusing on socially significant behaviors to improve the lives of individuals through various interventions (Cooper, Heron, & Heward, 2007). Applied behavior analysis stems from Skinner's behavioral principles, which subsequently led to the development of strategies to improve human behavior. Tactics such as active student engagement, repeated practice, and supportive feedback, in part, lead to the development of specific and observable behaviors that are adaptive for individuals (Skinner, 1953). The present study addressed each of these components. Participants were engaged while receiving the prompts and completing the target behavior. They had numerous opportunities to practice the behavior, and they received supportive and corrective statements from the researcher via the CAC earpiece. The feedback that they received through CAC, either praise or corrective statements, was contingent upon whether the participants demonstrated the target behavior of attending correctly. The target behavior was defined in a way that made it observable to the researcher as well as the additional observer who assisted with data collection. The presence or absence of the observable behavior determined the kind of performance feedback each participant received.

Through the use of CAC, instructors are able to give performance feedback, a component of behaviorism, to the individual being supported. According to Daniels (1989), performance feedback consists of delivering praise and corrective statements

contingent upon performance. The use of performance feedback has been documented in the literature as being effective with students, teachers, and employees. Barbetta, Heward, Bradley, and Miller (1994) compared immediate versus delayed error correction on the acquisition and maintenance of sight word recognition of elementary school students. The authors found that providing students with immediate feedback yielded better immediate and long-term results than delayed feedback. Coulter and Grossen (1997) examined the effects of performance feedback on pre-service teachers. The authors compared in-class and after class feedback, and found that delivering performance feedback while the teacher was teaching resulted in better outcomes rather than waiting until the class was over to deliver feedback. The authors posited that this was because the immediate feedback allowed the teachers to practice the correct skill rather than repeat the instructional error multiple times before they were given feedback (Coulter & Grossen, 1997). Rogan, Luecking, and Grossi (2007) studied workplace supports for employees. The authors found that in order for employees to perform at the most effective and efficient levels, they require support often and discreetly (Rogan et al., 2007). These studies demonstrate that performance feedback as part of a behavioral intervention can be viewed as effective for individuals across ages, settings, and abilities. Participants in this study received performance feedback to encourage them to engage in the target behavior. Effective prompting is dependent upon “a trainer’s ability to deliver the right prompt, at the right time, and with high probability that the prompt will be present in naturally occurring interactions” (Oliver & Brady, 2014, p. 112). Covert audio coaching provides a means to deliver effective prompting due to its discreet, real-time nature.

While CAC's outcomes for employers, parents, and teachers are well established, this intervention has not been applied in a classroom setting to support children with ASD. Throughout the past six decades, CAC has shown promising results for teacher preparation, parent education, and employment support by incorporating behavioral principles. The current study extends this literature base by using CAC to focus specifically on a classroom skill of students with ASD.

### **Purpose of the Study**

The purpose of this study was to examine CAC as a potential intervention strategy for increasing the instances of attending behavior of elementary students with ASD through the delivery of performance feedback. Studies show that children with disabilities are sometimes referred for placement in special education settings as a result of their behavior (e.g., Briesch, Ferguson, Volpe, & Briesch, 2012), which may include violating classroom rules and routines. Therefore, the overarching goal of the study was to increase the instances of attending so that the participants can follow classroom rules and spend more time in the classroom setting. Using discreet and systematic feedback, the current study was designed to increase instances of attending of children with ASD in a classroom setting.

### **Research Questions**

This study investigated the effectiveness of CAC on the classroom skill of attending of four elementary students with ASD in the classroom setting. Two research questions were addressed in this study:

1. Does the use of CAC increase the instances of attending in the classroom setting?

2. If improvements are made, to what extent are they maintained (i.e., weekly intervals for four weeks) once the intervention and CAC equipment are removed?

### **Summary**

The number of students with ASD attending U.S. schools is increasing at a faster rate than any other disability category (USDOE, 2015). The social needs of students with ASD are of special concern to educators as this population is likely to spend time in the general education classroom setting. In 2012, 90% of students with ASD spent time in a general education classroom, with 61% of students with ASD spending 80% or more of their school day in the general education classroom (USDOE, 2016). For students with ASD who attend private or charter schools, their LRE may still be a classroom setting, where they are surrounded by peers and experience countless social, academic, and basic classroom functioning demands throughout the school day.

Certain classroom skills, which stem from social skills (Merrell & Gimpel, 2014), are needed by all students to cope with the demands of the classroom setting. Specific classroom skills include waiting, listening, and interpreting nonverbal signals from others (Bonar, 2015). Interventions targeting the classroom skills of children with disabilities, a population for whom classroom skills may not be inherent, are plentiful, but there is a paucity of studies that examine CAC as an intervention method for the population learning these skills. Indeed, much of the CAC literature targets adults without disabilities, and few studies include individuals with disabilities. According to a review of CAC literature, the Price et al. (2002) study was the first and sole attempt to use CAC with a child with a disability needing support during instructional time. Although their study focused on the classroom skills of a student with a disability, there is no published



research that uses CAC as an intervention to support students with ASD in the classroom setting. The current study used CAC in an attempt to increase the instances of a classroom skill of students with ASD in the classroom setting.

### **Operational Definitions**

#### *Attending Behavior (as defined for the current study)*

Attending behavior includes eyes looking at teacher/work/student who is sharing, feet on floor/still, still body, hands resting on desk, sitting upright in chair, sitting/facing forward in chair, head up, head facing direction of teacher/work/student who is sharing, quiet mouth and body.

#### *Autism Spectrum Disorder*

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by pervasive deficits in social communication and social interaction, and restricted or repetitive patterns of behavior, interest, or activities. These deficits must be present in a child's early developmental period (Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition [DSM-V]; APA, 2013).

#### *Classroom Skills*

Classroom skills include "...certain behaviors that seem necessary for learning to take place in a classroom" (Koegel & Rincover, 1974, p. 46). Examples of classroom skills are raising hand before speaking, taking out materials when the teacher instructs to do so, and looking at the teacher when he/she is talking.

#### *Corrective Feedback*

Corrective feedback involves responding to an error with instructions on what to do in future occurrences.

### *Covert Audio Coaching*

Covert audio coaching (CAC) is a form of coaching and performance feedback that involves an instructor and a participant communicating from a distance. The instructor and the participant each have a two-way radio, and the participant wears an earpiece. Using the two-way radio, the instructor can deliver feedback to the participant in real time, from a distance, and without anyone except the participant knowing that they are being supported.

### *Performance Feedback*

Performance feedback, according to Daniels (1989) is when information on past performance is given to an individual, which allows them to change performance in the future. Performance feedback can be delivered in many forms including verbally and graphically.

### *Prompting*

Prompting refers to stimuli that function as extra cues and reminders for desired behavior. Prompts can be visual, physical, or auditory (Cooper et al., 2007).

### *Social Skills*

Social skills are specific behaviors used in social situations to produce desirable social outcomes (McFall, 1982).

### *Supportive Feedback*

Supportive feedback involves responding to desirable behavior by delivering praise or reassuring statements.

## **CHAPTER II**

### **LITERATURE REVIEW**

The number of students with Autism Spectrum Disorder (ASD) in U.S. schools is increasing faster than any other disability (U.S. Department of Education [USDOE], 2015). The needs of the ASD population are of importance to educators, as students with ASD are likely to spend some time in a typical classroom setting throughout the school day. In this environment, where they are surrounded by their peers, students experience many social and basic classroom functioning demands. These classroom demands can be problematic for these students as deficits in social skills are at the core of the disorder. In order for students with ASD to function in the classroom setting in a way that is socially and age appropriate, they must receive the necessary supports. Therefore, the purpose of this literature review is to discuss: (a) characteristics of individuals with ASD, (b) educational placement of students with ASD, (c) applied behavior analysis, (d) interventions for classroom skills, and (e) covert audio coaching.

#### **Characteristics of Individuals with Autism Spectrum Disorder**

The Centers for Disease Control and Prevention (CDC) published its most recent report on ASD in 2013, which indicated that ASD affects 1 in 68 children in the United States. The incidence of this disorder increased by 30% from the CDC's 2011 report, but remains more prevalent among boys than girls, affecting 1 in 42 boys compared to 1 in 189 girls (CDC, 2013). In an effort to make diagnosing ASD more precise and to allow clinicians to describe specific symptoms more accurately, diagnostic criteria were updated in 2013 (American Psychiatric Association [APA], 2013).

Autism Spectrum Disorder is a developmental disability characterized by marked deficiencies in communication, social interaction, and repetitive and restricted behaviors and interests (CDC, 2013). The first clinical account of ASD was made by Leo Kanner in 1943. Kanner was a child psychologist at Johns Hopkins University who observed 11 socially isolated children and described them as demonstrating “extreme autistic aloneness” (Kanner, 1943, p. 242). Out of the 11 children that Kanner observed, eight were boys and three were girls. The gender breakdown of these children is meaningful, as Autism Spectrum Disorder is still more prevalent among boys than girls.

At the time of diagnosis, individuals, the majority of whom are diagnosed as children (CDC, 2013), must meet two diagnostic criteria to a certain extent. These criteria include: (a) restricted or repetitive patterns of behavior and interests, (b) and deficits in communication and social interaction (APA, 2013). Additionally, diagnostic criteria prescribed in the Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (DSM-V) state that symptoms must be present during the child’s early developmental period, cause clinically significant impairment in functioning, and are not explained by other disorders (APA, 2013). Although individuals with ASD share the same diagnosis, the severity of their symptoms may differ completely (Morris, Kirschbaum, & Picard, 2010; Gaus, 2011). Functioning among individuals with ASD ranges from individuals who are mute, attend specialized schooling, and do not hold employment as adults, to individuals with advanced verbal language who go to college, have steady employment, and have close relationships with others (Chiang & Wineman, 2014).

Despite any treatment that individuals with ASD may receive, ASD is a lifelong disorder. Therefore, symptoms can only be alleviated. While the cause of this disorder

remains unknown, some hypothesized causes have been ruled out since ASD was first discovered. It is now understood that ASD does not result from the unattached parenting styles of mothers (c.f., Kanner, 1943), nor is it caused by adverse reactions to childhood vaccinations (DeStefano, Price, & Weintraub, 2013; Madsen, 2004). The most likely cause of ASD is believed to be an interaction of genetic and environmental factors that cause abnormal brain development in utero (Kim & Leventhal, 2015; LaSalle, 2013). Regardless of the cause, the growing prevalence indicates that many individuals, particularly children, require treatment and accommodations (Hattier & Matson, 2012).

In order for such treatment and accommodations for the ASD population to be effective, they should account for a myriad of learning barriers that children with ASD may have. Difficulty with imitation (Heimann, Nordqvist, Strid, Connant Almrot, & Tjus, 2016; Stewart, McIntosh, & Williams, 2013; Vivanti, Trembath, & Dissanayake, 2014), stimulus over-selectivity (Kelly, Leader, & Reed, 2015; Lovaas, Koegel, & Schreibman, 1979; Rieth, Stahmer, Suhrheinrich, & Schreibman, 2015), and attention issues (Landry & Bryson, 2004; Mattard-Labrecque, Amor, & Couture, 2013; Noterdaeme, Amorosa, Mildenberger, Sitter, & Minow, 2001) are the most common learning barriers students with ASD face, as documented in the literature. All of these deficits are viewed as necessary skills for learning, putting children with ASD at a substantial disadvantage when compared to children without disabilities.

With respect to how individuals with ASD learn best, the majority of literature asserts that children with ASD are visual learners (Earles, Carlson, & Bock, 1998; Kodak, Clements, & LeBlanc, 2013; Kozleski, 1991; Rao & Gagie, 2006) with poor receptive language abilities (Azouz, Khalil, Abdou, & Sakr, 2014; Carpenter, Estrem,

Crowell, & Edrisinha, 2014; Kellerman, Fan, & Gorman, 2005). Emerging literature, however, suggests otherwise. A 2013 study by Erdődi, Lajiness-O'Neill, and Schmitt compared the visual and auditory verbal learning abilities of 42 children with ASD and other developmental disabilities. Using a selective reminding format, which involves recalling items from a list, researchers found that participants with ASD had a faster rate of acquisition of verbal compared to visual information (Erdődi et al., 2013). The authors noted that the findings of this study are in contrast to current theories of learning in ASD and its connection with education. The findings of Erdődi and colleagues' study have important implications for how children with ASD are supported, as they contradict what has been understood for many years.

Similarly, Trembath, Vivanti, Iacono, and Dissanayake (2015) discovered similar results when they examined how children with ASD and similar disabilities manipulated objects while watching videos. Participants watched videos under two conditions: (a) speech only and (b) speech and pictures. While watching these videos, an actor instructed participants to manipulate objects while they were wearing an eye-tracking device. Results of this study showed that participants with ASD did not perform better under the speech and pictures condition, leading the authors to posit that there was no notable visual learning strength among that group of participants (Trembath et al., 2015).

The findings of these two studies show that previously recognized learning styles of children with ASD are not necessarily accurate, and that individuals with this diagnosis differ with respect to how they learn best. As they pertain to the proposed current investigation, the aforementioned studies demonstrate a need for more research on the learning styles of children with ASD.

Autism Spectrum Disorder is classified by restricted or repetitive patterns of behavior and interests, and deficits in communication and social interaction (APA, 2013). While these broad criteria vary among individuals with ASD, there is significant research on the learning styles of this population. Common barriers to learning for this population, like attention issues and stimulus over-selectivity, are particularly problematic because they hinder learning. There is conflicting research between whether individuals with ASD are in fact exclusively visual learners, which is the historically, and currently, widely accepted view. The heterogeneity among individuals with ASD presents an opportunity to explore ways in which learning barriers can be addressed while emphasizing the strengths of this population.

### **Educational Placement of Students with Autism Spectrum Disorder**

The educational placement of children with ASD in public schools typically depends on the severity of their symptoms and their IQ scores (Kurth, 2015). There is a substantial variance, however, between the academic, social, and behavioral functioning of children with ASD. Thus, there is no “one size fits all” solution when it comes to the placement of students with ASD in public schools. The least restrictive environment (LRE) for students with ASD is dependent upon the individual child, not just their disability category. The Individuals with Disabilities Education Improvement Act (IDEIA) is a federal law that dictates how states provide special education services to children with disabilities (2004). The IDEIA mandates that children in public schools with disabilities must be educated alongside their typical peers to the greatest extent possible (IDEIA, 2004).

The USDOE outlines placement options for students with disabilities across the country. The continuum of services includes the following placement settings, listed from most restrictive to least restrictive: (a) separate school, (b) separate class, (c) pullout programs, and (d) general education class (USDOE, 2015). Separate school settings, which are the least common special education setting on a national scale, include placements such as separate day schools, homebound or hospital environments, and residential facilities (McLeskey et al., 2012). Next on the continuum is separate classes, which can be categorized by disability, (e.g., ASD, emotional or behavioral disorders [EBD]), or disability and range (e.g., a school may have an EBD class for students in third through fifth grade, and another for students in fourth through sixth grade; Kauffman, Bantz, & McCullough, 2002). The pullout option is most prevalently used for students with disabilities (USDOE, 2015). The pullout placement, which is in actuality two placements, involves the student being pulled out from the general education classroom setting and moving to a special education setting, such as a resource class. The student will spend any amount of time in that setting, most likely during subjects such as math and language arts, where they will work with a special education teacher in a smaller group setting (Crockett & Kauffman, 2013). The final and least restrictive setting on this continuum is the general education classroom setting. For students with ASD who are academically capable of being taught in the general education classroom and do not exhibit dangerous behaviors, the legal requirements of IDEIA may result in them being placed in this setting (Segall & Campbell, 2014).

Once in the classroom, whether for the entire school day or for a portion of it, students with ASD are met with countless academic and social demands. While these



demands (e.g., following the behavior of others, anticipating the next activity) may come easily or even naturally for students without disabilities, such skills are not inherent among children with ASD (Koegel & Koegel, 1995). To meet the needs of this population in the classroom setting, supports may be provided to the students in various ways. Depending on the resources at the particular school, students with ASD may have their own paraprofessional aide (Etscheidt, 2005), they may receive supports from the classroom or special education teacher (Segall & Campbell, 2012), or they may benefit from school-wide behavior support plans (Crosland & Dunlap, 2012; Parsonson, 2012). What are needed in classroom settings are evidence-based practices for students with ASD (Callahan, Henson, & Cowan, 2008; Hess, Morrier, Heflin, & Ivey, 2008). Such practices include applied behavior analysis (ABA), which is the most commonly used and most effective method for making behavior changes among children with ASD (Bloch & Axelrod, 2008; Loiacono & Allen, 2008).

The IDEIA (2004) requires that children with disabilities, including ASD, must be educated in the general education classroom to the fullest extent possible. This means that some children with ASD will spend a portion or the entirety of their school day in that setting. While being educated alongside students without disabilities provides opportunities for social interaction and communication, many children with ASD do not have these kinds of skills (Koegel & Rincover, 1974). Social interaction, communication, attending to teacher, and following directions are some examples of classroom skills that present challenges for children with ASD as a result of the nature of their disability. Evidence-based practices for this population are needed in order for them to fully benefit from their experiences in the general education classroom setting.

## **Theoretical Framework: Applied Behavior Analysis**

Applied behavior analysis is a discipline that uses principles of human behavior to improve the lives of individuals through interventions that focus on socially significant behaviors (Cooper, Heron, & Heward, 2003). Applied behavior analysis stems from the work of Watson, Thorndike, and Skinner, psychologists who each contributed to the study of behavior development. John Watson is considered to be the founder of the behaviorist theory, as he found existing explanations of behavior to be too theoretical and posited an opposing explanation after conducting experiments with children. In the early 1900s, Watson conditioned a child, Albert, to fear rats despite having liked a rat previously. Watson did this by producing a loud noise whenever the rat was in Albert's line of sight. After doing this for several weeks, Albert would begin to cry when he saw the rat that he had previously liked and even tried to pet at one point. Watson attributed Albert's change in response to the rat to the repeated pairing of a fearful sound with the presence of the rat (Watson & Rayner, 1920). Additionally, Albert began to fear objects that shared similar visual characteristics with the white rat, such as Santa Claus beards, leading Watson to assert that all behavior can be explained by how their experiences have programmed individuals to react (Watson, 1925; Watson & Rayner, 1920). Watson also postulated that behavior is most heavily influenced by the event(s) that precede it, known as the antecedent (Watson, 1925).

As Watson was exploring the principles of behavior through experiments with children, Edward Thorndike was doing the same thing, but with animals. Thorndike studied how cats escaped from cages, and over many trials found that the animals needed less time to escape. Thorndike attributed this to the attractive goal of getting out of the

cage, meaning that the experience of being free reinforced whatever behavior occurred immediately before the cat escaped (Thorndike, 1911). The results of this experiment led Thorndike to a separate conclusion about behavior than Watson. According to Thorndike, consequences are the most important factor of learning as they have the potential to shape behavior (Thorndike, 1911).

Immediately after Watson and Thorndike, B.F. Skinner refined their findings by building on their theories of the impact of antecedents and consequences on behavior. Skinner, like Thorndike, conducted his experiments with animals. In his most well known experiment, Skinner rewarded a pigeon with food pellets whenever it inadvertently raised its head (1948). Since obtaining food was a desirable experience, the pigeon began raising its head more frequently, and soon the pigeon was raising its head continuously. Skinner described this procedure as operant conditioning, since the pigeon's head raising operated on its environment (1948). Using operant conditioning, Skinner believed he could shape the naturally occurring behavior of subjects, regardless of whether the subject understood what was happening. In this way, behaviorists differ from other psychologists in that they place less emphasis on the importance of understanding as it is typically used. This difference in beliefs led Skinner to create the theory of radical behaviorism, which focuses on the relationship between observable stimuli and observable responses (1953). While he recognized that there is a sort of inner world within humans and animals that consists of thoughts and emotions, he did not believe that they could be reliably measured (Skinner, 1953). Therefore, Skinner asserted that such thoughts and feelings could not account for behavior; rather, they are more examples of behavior (1953).

In operant conditioning, behaviors are manipulated, in part, by either positive or negative reinforcement, both of which increase the likelihood of a behavior occurring by either adding or removing something to or from the environment. Skinner demonstrated these two types of reinforcement with rats (1938). When the rat engaged in desirable behavior, such as pushing a lever, Skinner would use positive reinforcement by rewarding them with food. In doing so, he added a desirable stimulus to the environment that made the desirable behavior more likely to occur in the future. To make the rat push the lever, Skinner would use negative reinforcement by giving the rat an electrical jolt. He would remove the jolt only when the rat engaged in the desired behavior. By doing this, he removed an undesirable stimulus from the environment, which also made the desirable behavior more likely to occur in the future when under this condition (1938).

Skinner also showed through his experiments with pigeons that behaviors can be altered through the use of punishment and extinction. The opposite of reinforcement, which seeks to increase the future frequency of behavior, punishment aims to decrease the future frequency of behavior. Positive punishment involves giving the subject an undesirable experience, such as a jolt of electricity as a consequence, which is what Skinner administered to pigeons when using this method (1948). Negative punishment, in contrast, involves removing a desired item after the undesired behavior happens. Extinction, which is also used to decrease behavior, involves previously reinforced behaviors being no longer reinforced, causing the behaviors to decrease in frequency as they become inconsequential. Skinner did this with animals by ceasing to provide them with food once they had been trained to push a lever to receive food. The animal would

press the lever less frequently and eventually stop altogether since it was no longer being rewarded with food.

Ayllon and Michael (1959) described one of the earliest applications of behavior analysis with human subjects. The study involved teaching nurses at a mental hospital to find and alter environmental variables that caused their patients to engage in problem behavior. The nurses were taught to use the behavioral strategies of extinction with and without reinforcement on the patients that they cared for. Overall, the patients' problem behaviors were improved as a result of their nurses applying the principles of behavior analysis.

Ivar Lovaas was among the first behaviorists to apply the findings of Thorndike, Watson, and Skinner to children with ASD. In his 1987 study, Lovaas used a method called Discrete Trial Teaching (DTT), to treat two groups of young children with ASD. One group of participants (the experimental group) received more than 40 hours of one-on-one treatment per week, and the other group (the control group) received 10 hours or less of one-on-one treatment per week. The study was two years in length, and treatment focused on both reducing undesirable behaviors (e.g., self-stimulatory behaviors and aggression) as well as teaching desirable behaviors (e.g., imitation, appropriate play, and communication). Follow-up results showed that the experimental group made significantly more gains than the control group, with 47% of participants achieving normal intellectual and educational functioning, compared to 2% of participants in the control group (Lovaas, 1987). In his discussion, Lovaas indicated that the treatment program could not be replicated without "prior extensive theoretical and supervised practical experience in one-to-one behavioral treatment with developmentally disabled

clients as described here” (Lovaas, 1987, p. 8). However, the treatment method he used in this study, referred to at the time as the Lovaas model, would become a tool in applied behavior analysis shortly after.

Applied behavior analysis continues to be one of the most effective methods for treating individuals, including children, with ASD (Axelrod, McElrath, & Wine, 2012; Matson et al., 2012). Applied behavior analysis involves systematically applying interventions on the basis of the principles of behavioral learning theory to improve socially significant behaviors and then demonstrating that the interventions employed were responsible for the improvement in behavior. Some of the specific strategies and techniques employed using ABA include: (a) shaping, (b) prompting and fading, (c) discrete trials, (d) stimulus control, (e) generalization, (e) chaining, (f) task analysis, and (g) data-based decision making. Pertinent to individuals with ASD is the ABA tenet that individuals must be treated as independent people, regardless of diagnosis (Cooper, Heron, & Heward, 2007; Miltenberger, Miller, & Zerger, 2015). This belief has important implications for individuals with ASD, as the disorder is a spectrum and manifests itself differently among individuals.

Baer, Wolf, and Risley (1968) discuss ABA used in an applied manner. The authors state that the dimensions of ABA include: (a) applied, (b) behavioral, (c) analytic, (d) technological, (e) conceptual, (f) effective, and (g) generality. The first element, its applied nature, refers to the importance of the problems being studied. The authors explain that in ABA, the behavior, stimuli, or subject being studied are selected because of their social significance, not their relation to theory (Baer et al., 1968). The behavioral component of ABA refers to how the subject’s behavior is measured. In ABA, what the

subject can do is of high importance. Behavior in ABA is studied using precise measurements, which means that the researcher must “try harder” (Baer et al., 1968, p. 93) to get the subject to demonstrate the target behavior. In order for behavior to be properly analyzed in ABA, a “believable demonstration” (p. 94) where events are the cause of the behavior, must be accounted for (Baer et al., 1968). Analysis of behavior can only be made if the experimenter can demonstrate control over it, by using strategies like reinforcement and prompting to make the behavior occur or not occur. The technological nature of ABA refers to how components of a given behavior are described and observed so that others can replicate the same procedures (Baer et al., 1968). Defining behavior in terms that are observable and measurable makes implementation and data recording consistent and valid. Conceptual systems are important in ABA, as they tie ABA to behavioral principles. Procedures used in studies must be described in ways that are both technical and relevant to behavioral principles (Baer et al., 1968). The effectiveness of ABA is an important dimension, as it separates applied research from non-applied research. While non-applied research can be valuable when it causes small effects, applied research relies on its practical importance to be seen as effective (Baer et al., 1968). The practicality of a behavior change is best determined not by its contribution to theory, but by the people directly affected by the change. The final dimension of ABA shared by the authors, generality, refers to a behavior change that continues after an intervention stops (Baer et al., 1968). This ties into the practicality of ABA, in that the more general a behavioral application is, the more functional it is.

The combination of principles of behaviorism with their use in applied settings has resulted in the treatment method now referred to as ABA. Watson, Thorndike, and

Skinner provided the framework for ABA through their research on the behavior of animals and human subjects. After the principles of behaviorism were developed, Lovaas applied them to individuals with ASD. The promising results he found from his 1987 study eventually lead to ABA being the most commonly used treatment method for individuals with ASD (Mohammadzaheri, Koegel, Rezaee, & Rafiee, 2014). ABA has been shown to improve the language, daily living skills, and social skills of individuals with ASD (Virués-Ortega, 2010). Applied behavior analysis has also been used to address skill deficits across settings, including the educational settings of children with ASD (Horner & Sugai, 2015; Kazdin, 2012).

### **Interventions for Classroom Skills**

Classroom skills have been the focus of interventions for children with behavior issues for decades. For students to experience success in the classroom, a certain amount of independent academic functioning is required (Crosland & Dunlap, 2012; McClelland & Morrison, 2003). While not specifically focusing on children with ASD, or any disability, researchers continue to be interested in improving the functioning of children in the classroom setting. One of the earliest studies on a classroom skill was by Hall, Lund, and Jackson (1968). The study, which used teacher attention to decrease disruptive behavior, used first-grade and third-grade elementary school students as participants. Participants were chosen on the basis of their demonstration of consistent disruptive and “dawdling” behavior (Hall et al., 1968, p. 1). The study used Skinner’s concepts of positive reinforcement and extinction. Positive reinforcement was used by the teacher giving participants attention when they demonstrated on-task behaviors. Extinction was used when teachers would ignore off-task behaviors, which had been previously



rewarded with attention. Results of the study showed that teacher attention was effective in reinforcing attentive study behavior in participants, and results were maintained during follow-up observations (Hall et al., 1968).

One of the earliest mentions of attending behavior in the literature is in a 1970 study by Broden, Bruce, Mitchell, Carter, and Hall. The authors successfully improved the attending behavior of two second grade boys who sat at adjacent desks. These boys were described as being the “most disruptive” (Broden et al., 1970, p. 199) students in their class. Using social reinforcement delivered by the teacher, the authors increased the instances of attending behavior of both participants. The authors defined attending behavior as writing, looking at appropriate materials, and looking at the teacher if she was talking. They defined non-attending as being out of seat without permission, talking to others without permission, looking at their peers, and other behaviors that were incompatible with being on task (Broden et al., 1970).

Two years later, a similar study was implemented, this time using tokens as reinforcements for attending behavior. Nine third-grade children participated in the experiment, and all participants’ attending behavior improved when they were given tokens for attending during math lessons (Ferritor, Buckholdt, Hamblin, & Smith, 1972). The authors defined attending in a similar way to the Broden et al. (1970) study. For the purposes of their study, attending behavior included looking at or writing on the appropriate paper, looking at the teacher, counting with fingers, counting aloud, sharpening pencil, or passing papers (Ferritor et al., 1972). The authors defined non-attending as looking anywhere other than the teacher or sitting with their eyes closed (Ferritor et al., 1972). The study also included the behavior of disrupting as a non-

attending behavior. Talking out, hitting, making sounds, playing with materials, and throwing materials were all examples of behaviors that were non conducive to attending, and if students were observed engaging in disruptive behavior, they were marked as not-attending during data collection intervals (Ferritor et al., 1972).

Another early example of the exploration of classroom skills of children with ASD was by Koegel and Rincover (1974). These authors defined classroom skills as “certain behaviors that seem necessary for learning to take place in a classroom” (Koegel & Rincover, 1974, p. 46). The specific skills focused on in their study, which sought to improve classroom skills of students with ASD, were: (a) attending to the teacher, (b) imitation, (c) speech, and (d) labeling parts of the immediate classroom environment (Koegel & Rincover, 1974). The authors used one-to-one teaching sessions to see if skills would transfer to the classroom setting. Results of the study showed that learning in the one-to-one environment was nominal, and no further learning occurred in the larger classroom setting (Koegel & Rincover, 1974). In the discussion portion of this paper, the authors focused on implications for the future of classroom programs for children with ASD. The authors stated that repeated exposure to the classroom environment does not automatically produce changes in behavior, but programs for this population have the potential to be effective (Koegel & Rincover, 1974). Although the study occurred before Lovaas’s study on DTT was published, the idea of one-on-one interventions being most effective for children with ASD is the focal point of this study. Like Lovaas would later postulate, intense, goal-oriented, one-on-one therapy sessions may be needed to teach behaviors to children with ASD, and the results of this study support his argument.

The most common classroom skill of children with ASD that is focused on in the literature is active engagement, as it is a skill with which students with ASD typically struggle. As a consequence of deficits in social awareness, students with ASD are “less likely to look at faces or respond and attend to relevant classroom instruction than their peers” (Sparapani, Morgan, Reinhardt, Schatschneider, & Wetherby, 2015, p. 2). To understand the difficulties with active engagement of this population, Dunlap and Johnson (1985) compared two versions of delayed contingencies to see which produced higher levels of active engagement in participants. The study followed Skinner’s concept of stimulus control, which indicates that the presence or absence of a stimulus (in this study the stimulus is the therapist) determines the behavior of an individual (the student). The authors wanted to see how the presence and absence of the therapist would affect the active engagement of participants. The study compared a predictable schedule of therapist supervision, which involved the therapist sitting next to the student and interacting with them while they completed an academic task, to an unpredictable schedule of supervision, which involved the therapist sitting with the student and working with them intermittently. Results showed that student engagement (i.e., looking at their work, completing tasks) was higher during periods of no supervision after an unpredictable schedule was used (Dunlap & Johnson, 1985) compared to periods of no supervision after a predictable schedule was used. The findings of this study have important implications for students with ASD, as an unpredictable schedule of supervision may result in less dependency on adult supervision (Dunlap & Johnson, 1985).

In 2000, Bryan and Gast used graduated guidance and visual schedules to increase on-task (i.e., looking at or using appropriate materials) and on-schedule (i.e., adhering to classroom routine) behavior of four elementary school students with ASD. They measured these behaviors using interval recording, and found that participants' on-task and on-schedule behaviors increased as a result of the intervention package they received. When the researchers checked for maintenance several weeks later, however, the participants' behaviors resumed to their original levels.

In 2004, Schilling and Schwartz used therapy balls as seats for four preschool children with ASD to help them pay attention in class. Participants had difficulty with attention and engagement during instructional time, which the authors mentioned is common among this population and important to address as it can “interfere with students' ability to participate in the educational mainstream” (Schilling & Schwartz, 2004, p. 423). The authors defined engagement as the student being oriented towards the classroom activity, materials or person speaking. They also defined non-engagement as the student not being oriented towards the appropriate activity or teacher, such as staring at a person or object that is unrelated to instruction (Schilling & Schwartz, 2004).

More recently, Holifield, Goodman, Hazelkorn, & Heflin (2010) used a self-monitoring checklist to increase attending to task of two elementary school students with ASD. The authors stated that the ability to attend to academic tasks is a prerequisite skill for academic success, but that such skills are often insufficient in students with disabilities (Holifield et al., 2010). Self-monitoring checklists are a form of ABA that can be easily implemented in classrooms, and they can be useful for general education classroom teachers who have students with ASD in their classrooms. The study took

place in a self-contained classroom for students with ASD, and participants monitored their attending to task as well as academic accuracy via a self-monitoring checklist during language arts and mathematics lessons. During language arts lessons, attending to task involved any of the following behaviors: (a) reading aloud, (b) writing or erasing on worksheets, (c) following teacher directions, and (d) asking or answering questions (Holifield et al., 2010). During mathematics, attending to task involved any of the following behaviors: (a) reading, writing, or erasing on worksheets, (b) counting manipulatives, (c) following teacher direction, and (d) asking or answering questions (Holifield et al., 2010). In the study, the self-monitoring intervention was successful for both students, with their attention to task increasing as a result of the intervention (Holifield et al., 2010), therefore contributing to the options available for supporting children with ASD in classroom settings.

In 2011, Nicholson, Kehle, Bray, and Heest used an observational tool called the Behavioral Observation of Students in Schools (BOSS; Shapiro, 2003) to measure instances of student behavior. The researchers concluded that students with ASD spent 31-48% of class time on-task, and sought to address the off-task behavior by providing students with a physical intervention of jogging and running before class. Once they had engaged in physical activity, on-task behavior increased to 42-67% of class time. Follow-up data show that on-task behavior decreased once the intervention was removed but that some students remained slightly above their baseline levels (Nicholson et al., 2011).

Researchers at the University of Georgia were also interested in how to increase the on-task behavior of children with disabilities in the classroom setting. They examined how physical activity affected the on-task behavior of five children with significant

developmental delays in a special education preschool classroom (Luke, Vail, & Ayres, 2014). The researchers noted that the concept of on-task behavior is defined in the literature in different ways, such as attention to task, academic engagement, and learning related social skills, but for the purpose of this study, on-task behavior was defined as: (a) looking at teacher, (b) keeping hands to self, and (c) singing or imitating movements to songs or poems (Luke et al., 2014). Researchers compared the effects of physical activity versus seated center activities for 20 minutes before a teacher-led group activity. Results of this study showed that engagement in physical activity prior to a teacher-led group activity resulted in higher on-task behavior than engaging in seatwork prior to the activity. These results suggest that physical activity can be a useful proactive measure to increase the likelihood of on-task behavior of children with developmental delays in a classroom setting (Luke et al., 2014).

Sparapani and colleagues further emphasized the lack of active engagement demonstrated by elementary students with ASD in a 2015 study. The active engagement times of students with ASD in kindergarten, first, and second grade were evaluated using an observational tool called the classroom measure of active engagement (CMAE). The CMAE quantifies active engagement as students demonstrating emotional regulation, classroom participation, social connectedness, initiating communication, and being flexible (Sparapani et al., 2015). The tool was created to measure active engagement of students with ASD, and was used in this study to record active engagement times of participants who had been video-recorded in the classroom environment. Results of the study found that overall, participants spent less than half of the observation sessions being productive, well regulated, and independent (Sparapani et al., 2015). The authors

also found that participants rarely directed their eye gaze appropriately or communicated with others (Sparapani et al., 2015). The findings of the study further demonstrate the learning barriers of children with ASD as mentioned above, specifically stimulus over-selectivity and attention issues. Participants in the study, as is common among children with ASD, were unable to select which stimuli in their environment were important, such as the teacher giving directions or the academic task at hand. Similarly, they were consistently not paying attention to the teacher or other students in their classroom. While these findings are not new, they show how these learning barriers are present in the classroom, as well as the severity of the deficit. Spending less than half of the observation sessions being productive indicates that simply placing students with ASD in a classroom is not enough; they must be supported in such a way where they can benefit from being in that setting.

In addition to production during class time, specific classroom skills that are similar by definition like attending to teacher (Koegel & Rincover, 1974), active engagement (Dunlap & Johnson, 1985), and attending to task (Luke et al., 2014) have been examined. Positive reinforcement (Hall et al., 1968), one-on-one attention (Koegel & Rincover, 1974), and self-monitoring checklists (Holifield et al., 2010) are some of the ways in which these classroom skills of children with ASD have been addressed. While some studies resulted in positive behavioral changes, further interventions that target the strengths of children with ASD while addressing skill deficits are still needed if they are to succeed in demonstrating these skills in the classroom setting.

## **Covert Audio Coaching**

Covert audio coaching (CAC) is a form of performance feedback that involves an instructor and a participant communicating with each other from a distance. The instructor and the participant, who is receiving support, each have a two-way radio, and the participant wears an earpiece. Using the two-way radio, the instructor can deliver feedback to the participant in real time without anyone except the participant knowing that they are being supported. The covertness of CAC is because of the size of the earpiece device itself and the distance from which the instructor can be from the participant while still delivering real time feedback. CAC can be used to both develop and enhance skills of participants (Bennett, 2013).

Through the use of CAC, instructors are able to give performance feedback to the individual being supported. According to Daniels (1989), performance feedback consists of delivering praise and corrective statements contingent upon performance. The use of performance feedback has been documented in the literature as being effective with students, teachers, and employees. Barbetta, Heward, Bradley, and Miller (1994) compared immediate versus delayed error correction on the acquisition and maintenance of sight word recognition of elementary school students. The authors found that providing students with immediate feedback during instructional time yielded better immediate and long-term results than when they provided delayed feedback to the participants after class (Barbetta et al., 1994). Coulter and Grossen (1997) examined the effects of performance feedback on pre-service teachers' use of teaching strategies. The authors compared in-class and after class feedback, and found that delivering performance feedback while the pre-service teachers were teaching resulted in better



outcomes than waiting until the class was over to deliver feedback. The authors suggested that this was because the immediate feedback allowed the pre-service teachers to practice the correct skills rather than repeating the error multiple times before they were given feedback (Coulter et al., 1997).

In 2007, Rogan, Luecking, and Grossi made the case for discreet performance feedback when they studied workplace supports that were in place for employees with disabilities. The authors found that in order for these employees to perform at the most effective and efficient levels, they required supports as often as necessary and as inconspicuous as possible (Rogan et al., 2007). Such discreetness of performance feedback is the foundation for CAC, as it is not noticeable to anyone other than the participant and the coach. Performance feedback delivered via CAC adheres to the principles of ABA, as it is conceptually systematic. Procedures are built from the basic principles of behavior, and findings are related to them as well. Performance feedback, when delivered in this manner, can function as positive reinforcement, negative reinforcement, and positive punishment. If the participant engages in a target behavior and the researcher delivers a praise statement, positive reinforcement may have been provided in the form of the statement. If the participant engages in a target behavior and the researcher does not deliver a correction statement, it is possible that negative reinforcement occurred, as the correction statement is being withheld. If the participant does not engage in a target behavior and the researcher delivers a correction statement, positive punishment may be in effect, as the statement could be unfavorable outcome that is meant to decrease the likelihood of that behavior occurring in the future.

## **Covert Audio Coaching for Practitioners and Caregivers**

The earliest study using CAC was by Korner and Brown in 1952. The researchers wanted to deliver feedback to their psychotherapy students while they were working with patients. Due to the mental state of some of the patients, the researchers knew that in order for the patients not to have a negative reaction to their psychotherapist being instructed on what to say, feedback would need to be delivered discreetly and from a substantial distance. The researchers decided on a two-way audio device, which they called the mechanical third ear, and were able to deliver feedback in real-time to their students without the patients' knowledge (Korner & Brown, 1952).

Similarly, in 1976, Baum and Lane were searching for a way to support their counseling interns while they were leading sessions with patients. Dissatisfied with the standard method of watching through a one-way mirror and having to wait until the session was over to instruct the interns on their performance, the researchers used CAC to deliver feedback to their interns in real-time. They found that their interns were able to correct their mistakes immediately, and as a result of the CAC, the sessions were more successful both for the interns and the patients with whom they were working (Baum & Lane, 1976).

Approximately twenty years after the Baum and Lane (1976) study, CAC was used to support pre-service teachers. In 1994, Giebelhaus used CAC to support pre-service teachers who were working on demonstrating discreet teacher clarity behaviors. Unlike the two earlier studies that used CAC, Giebelhaus (1994) did not see positive results from this study. There were conflicting reports between the pre-service teachers and their supervisors in terms of how effective the intervention was (Giebelhaus, 1994).

Lindell (2001) expanded on Giebelhaus' (1994) study, and found undesirable results as well. Lindell used CAC to audio cue pre-service teachers as they were demonstrating teaching skills, as Giebelhaus (1994) did. Lindell (2001) found that even though the participants reported positive impressions of the intervention, meaning they enjoyed using CAC technology and felt it helped them improve their teaching skills, the data showed that few gains were actually made (Lindell, 2001). This study, like the Giebelhaus (1994) study, cited technical difficulties and unfamiliarity with the technology as explanations for their results. Even though the teachers were able to communicate with the students, technical issues like background noise and the earpiece falling out of the participant's ear prevented accurate analysis of the intervention itself. Since these two studies were conducted, CAC technology has advanced considerably and now the equipment is smaller and easier to use than former devices. Moreover, coaching tactics have been refined since these studies (e.g., coaches deliver concise and explicit statements; Bennett, 2013).

Scheeler and Lee (2002) later examined the use of CAC in helping teachers deliver three-term contingencies to their students. The researchers assisted novice (within the first three years of their teaching careers) special education teachers in completing three-term contingencies during their lessons. The authors described a three-term contingency as: a teacher-delivered prompt, followed by a student action, followed by a teacher-delivered consequence (Scheeler & Lee, 2002). Unlike the two studies mentioned above, the researchers found that the use of CAC was effective across participants in improving their delivery of three-term contingencies.

In 2006, Scheeler, McAfee, Ruhl, and Lee expanded on the previous study by using CAC to improve teacher delivery of three-term contingencies. The researchers measured student behavior in addition to teacher behavior. Using the same premise as Scheeler and Lee's (2002) earlier study, researchers delivered praise, guidance, and supportive statement to novice special education teachers. Similar to the 2002 study, the teachers' delivery of three-term contingency units improved as a result of the intervention. The researchers also found that as a result of the teachers' behavior improving, the students' behavior improved as well. They found that as the teachers delivered more three-term contingencies, their students exhibited fewer undesirable behaviors (Scheeler et al., 2006).

A study by Goodman, Brady, Duffy, Scott, and Pollard (2008) used CAC to measure teachers' delivery of learn units (the combination of a teacher-delivered antecedent, student behavior, and teacher-delivered consequence) in a classroom. The authors used pre-service teachers, and supported them via CAC in an effort to assist them in completing what they referred to as one of the most important teaching skills (Goodman et al., 2008). The results of the study showed that the teachers' delivery of successful learn units improved as a result of the CAC intervention, and the results maintained when the researchers checked for follow up (Goodman et al., 2008).

Shifting from teachers supporting students to teachers supporting other teachers, Scheeler, Congdon, and Stansbury (2010) used CAC as a means for co-teachers to support one other. The authors chose to look at this topic because of the increase in co-teaching in U.S. public schools, as well as the documented benefits of peer coaching (Scheeler et al., 2010). The teachers who participated in this study were general education

and special education teachers, and they were paired with their corresponding co-teacher to deliver support to each other via CAC. The results of the study showed that after receiving support via CAC from their co-teaching partner, the participants' teaching skills, which included classroom management and instructional strategies, improved (Scheeler et al., 2010).

In 2010, Nepo examined the effects of CAC as part of an intervention package to support instructors of adolescents with ASD. The researcher sought to improve the skills and strategies used by instructors of adolescents with ASD in a clinical setting. The researcher found that when used as part of an intervention package, the performance of staff members implementing ABA strategies with adolescents with ASD improved when part of an instructional package that included CAC, video clips, and graphs (Nepo, 2010).

Also concerned with how adults who work with children with ASD can influence their skillset, Ottley and Hanline (2014) used CAC to assist preschool teachers in helping their students develop expressive communication skills (e.g., requesting, labeling, holding conversation). Citing the importance of early childhood education and its role in aiding the communication development of children, the authors chose to focus on the communication skills of students by assisting their teachers (Ottley & Hanline, 2014). The researchers instructed the teachers as to which teaching strategies should be used to assist their students in developing expressive communication skills. The researchers explained the skills to the teachers, and then collected data during whole-group instruction. The researchers measured the frequency of the teachers' strategies as well as the students' instances of expressive communication. The results of this study showed

that at least one strategy per educator improved, and students were exhibiting more expressive communication (Ottley & Hanline, 2014).

Once success had been shown using CAC with teachers, Oliver and Brady examined its effectiveness with parents. They used CAC with mothers of children with ASD in 2014 to make discipline more consistent across children's environments. The researchers saw disconnect between how the participants were being disciplined at home and at school, and noted that consistency across environments was necessary for participants to consistently demonstrate appropriate behavior (Oliver & Brady, 2014). The researchers taught mothers of children with ASD how to appropriately deliver prompting and praise statements to their children at home. They were interested in seeing whether the parents could master the skill, as well as whether the children's behavior would improve as a result. The results of this study showed that the children's behavior improved as a result of their mothers receiving the CAC intervention (Oliver & Brady, 2014).

### **Covert Audio Coaching for Individuals with Disabilities**

In addition to being used with people who support individuals with disabilities, CAC has also been used to support individuals with disabilities themselves. Price, Martella, Marchand-Martella, and Cleanthous published the first study using CAC with a student with a disability in 2002. The authors used CAC to decrease inappropriate verbalizations of a 10-year-old boy with Attention Deficit-Hyperactivity Disorder (ADHD) in his classroom. Researchers delivered prompting and reinforcement statements via the participant's earpiece. Results of the study showed that the intervention was successful in decreasing the instances of inappropriate verbalizations for

the participant. Price and colleague's CAC study, which is the only current published study to focus on a child with a disability in the classroom setting, is the most significant study in terms of the current study as positive outcomes were shown for the student as a result of being supported via CAC in his classroom. While the study used CAC to reduce the frequency of a behavior, the proposed study sought to increase the frequency of a behavior. The principles of behavior, however, were applied in the same manner.

Covert audio coaching was used again to support students with disabilities in a study in 2010 by Scheeler, Macluckie, and Albright. Researchers used CAC as a means for peers to support each other while preparing to deliver a speech. The four participants were senior students with disabilities at a vocational high school in Pennsylvania, and one of their graduation requirements was to deliver a speech to their classmates. The researchers placed the students in pairs, and had them deliver support via CAC while their partner practiced delivering their speech. What is unique about this study is that the participants chose both the target behaviors and the prompts they wanted to be told. For example, one of the students wanted to fidget less as she spoke, so she had her peer deliver the vocal prompt, "still" (Scheeler et al., 2010). Though the CAC intervention was not used during the actual delivery of the speech, the researchers found that as a result of the CAC intervention, all four participants decreased their target behaviors. Additionally, all participants reported that they enjoyed using the technology and would like the opportunity to use it in other academic areas (Scheeler et al., 2010).

In 2010, Bennett, Brady, Scott, Dukes, and Frain used CAC outside of the classroom to increase on the job performance of adults with disabilities. The participants were performing skills at various job sites with the assistance of job coaches. Each

participant was responsible for performing different tasks at their job, such as cleaning windows and stacking milk crates. The researchers were interested in learning if CAC would increase the accuracy and speed at which the participants successfully completed their tasks. Through CAC, researchers delivered praise, guidance, and corrective feedback to the participants (Bennett et al., 2010). The results of this study showed that the participants not only mastered their skills, but they also maintained their level of efficiency when the researchers followed up later.

Because of concern for the employment outcomes of individuals with disabilities, Allen, Burke, Howard, Wallace, and Bowen (2012) wanted to teach individuals with ASD to promote products in retail stores as part of their vocational training. The researchers first tried teaching the participants the skills of promoting products via a video modeling intervention, but found it to be unsuccessful (Allen et al., 2012). The researchers then tried CAC to support the participants while they were working in retail stores as mascots who promoted certain products to customers. The researchers found that CAC was effective overall, and attributed its success to the fact that the participants were receiving feedback in real time, which was easier than giving them feedback after the fact, then the participants having to remember what was said in the middle of a future encounter with a customer (Allen et al., 2012). They did, however, find that once the CAC intervention was removed, the instances of the target behavior decreased. The authors attributed this to the length of the sessions, which were brief, as well as prompt-dependency of individuals with ASD (Allen et al., 2012).

Bennett, Ramasamy, and Honsberger (2013a) also used CAC to teach clerical skills to adolescents with ASD. The researchers noted that clerical skills are important for



individuals with disabilities to learn as they can lead to employment, which is typically difficult for that population to obtain (Bennett et al., 2013a). The participants were taught how to photocopy via guidance and praise prompts delivered through an earpiece. This study was effective in teaching participants how to photocopy, as all participants mastered the skill in 4-5 sessions (Bennett et al., 2013a). Additionally, the skills were maintained once the researchers followed up weeks later. These authors conducted an additional study that year using CAC to teach three high school students with ASD to fold T-shirts using a T-shirt folding board (Bennett, Ramasamy, & Honsberger, 2013b). All participants experienced an increase in fluency and accuracy as a result of the CAC intervention, and initial results of 100% accuracy in folding T-shirts maintained for four weeks after the intervention was removed.

The studies discussed above that dealt with supporting students with disabilities in the classroom setting (Price et al., 2002; Scheeler et al., 2010) provide the examples for the current study. They demonstrated that CAC can be used to modify the behavior of students with disabilities who are experiencing difficulties in the classroom setting, particularly the 2002 study, as it involves CAC being used during instructional time. Moreover, the studies by Allen et al. (2012), Bennett et al. (2010), and Bennett et al. (2013a, 2013b) demonstrated that the tactic could be successfully used to increase the skills of individuals with ASD. Using a combination of behavior principles and technology similar to those used in the aforementioned CAC studies, the current investigation sought to increase the attending behavior of students with ASD who may benefit from a targeted, individual intervention, such as CAC.

## Summary

This literature review discusses the potential of CAC interventions in the classroom, specifically their use for improving the classroom skills of elementary school students with ASD. Since ASD is a disorder characterized by a significant deficit in social functioning (APA, 2013), students with ASD who spend time in a classroom often do not pick up on social cues throughout the school day as their typical peers do (Anderson & Thompson, 2016). Therefore, these students require specific, evidence-based supports in order to assist them in participating in the classroom environment in a way that involves, rather than isolates them (Chamberlain, Kasari, & Rotheram-Fuller, 2007).

Classroom skills such as attending are of particular importance as they are skills that are required throughout the school day but are taught only informally to students (Cartledge & Milburn, 1978; McClelland & Morrison, 2003). Students without disabilities are largely able to demonstrate these skills by simply following others or using previous knowledge and applying it in the classroom setting (Toro, Weissberg, Guare, & Liebenstein, 1990). Students with ASD, however, are not always afforded this capability. Several evidence-based interventions have been used to address this issue, although ABA methods continue to be the most effective way to teach classroom skills to children with ASD. Using the principles of ABA, CAC provides a chance to improve the classroom skills of students with ASD using a method that is a promising practice but with limited support at this time.

Research on CAC has focused on its use with practitioners and caregivers, and more recently on individuals with disabilities. An electronic review of the literature

shows that there is currently only one published study that examines the effectiveness of CAC on a classroom skill of a child with a disability in the classroom setting. Currently, no published research uses CAC to support any classroom skills of children with ASD in the classroom setting. This gap in the literature provides an opportunity to explore this emerging technology as a means to support this population in a way that is specific to the symptoms of their disorder.

## **CHAPTER III**

### **METHOD**

This study investigated the effectiveness of using covert audio coaching (CAC) to increase the instances of attending of elementary school students with Autism Spectrum Disorder (ASD) in the classroom setting. This study explored the effect of using an earpiece connected to a communication device (e.g., ear bud speaker connected to a two-way radio) to provide immediate performance feedback on the attending behavior of each participant. Chapter III provides information on the study's participants, setting, materials, independent and dependent variables, data collection system, experimental design, procedures, data analysis, and social validity.

#### **Participant Information**

The current study involved four participants. Five participants were recruited, and the first four who consented were selected. Participants were elementary school students at a private school for children with ASD, and were selected by the researcher following teacher nomination. The researcher distributed an informational flyer for educators to recruit potential participants. The flyer was submitted to the Florida International University (FIU) Institutional Review Board (IRB) for approval prior to distribution.

Participants each had a primary diagnosis of ASD, and experienced difficulty attending to teacher and tasks as per teacher report. Participants did not have any auditory processing or hearing issues. Participants were responsive to supportive and corrective feedback prior to the start of the study. These skills were imperative for participants to not only participate but also potentially benefit from this intervention, as if they do not understand what the researcher is saying, or if they cannot process the information that

the researcher is giving to them, then the effects of CAC will not be able to be measured properly. These potential confounding variables were accounted for by observing each participant during class time and discussing concerns with their teachers and parents.

### **Participant Characteristics**

Jacob (pseudonym) was a seven-year-old, Hispanic boy. He had a diagnosis of ASD, and his Childhood Autism Rating Scale-Second Edition (CARS-2) score was 16, indicating minimal to no symptoms of ASD. According to responses on the CARS-2, his intelligence level was normal and consistent across areas. Responses to the CARS-2 also indicated that he could follow multistep directions in both English and Spanish, and typically demonstrated age-appropriate listening responses, though he was somewhat distracted during instructional time. Jacob showed no evidence of difficulty or abnormality when relating to others. He consistently demonstrated appropriate imitation of words and movements. Jacob showed age-appropriate emotional responses to peers and adults, and demonstrated an appropriate usage of nonverbal communication.

Claire (pseudonym) was an eleven-year-old, Caucasian girl. Her CARS-2 score was 32.5, indicating mild to moderate symptoms of ASD. Information from the CARS-2 suggested that she demonstrated mildly abnormal intellectual functioning. The CARS-2 also indicated that she could follow multistep directions in English, and demonstrated moderately abnormal listening responses in class. Claire had fairly abnormal relationships with others, as she was often aloof and did not independently initiate contact with others. She demonstrated appropriate imitation of words and movements. Claire showed signs of inappropriate emotional responses, often laughing at things that were not comical or becoming upset for no apparent reason.

Ryan (pseudonym) was a six-year-old, Hispanic boy. His CARS-2 score was 32, which indicates mild to moderate symptoms of ASD. He demonstrated mildly abnormal intellectual functioning according to information obtained using the CARS-2. He could follow one and two-step directions in English. He could also communicate in Spanish. Data from the CARS-2 suggested that Ryan was consistently distracted by sounds in class and would react to sounds that others did not notice by staring in the direction of the noise, such as a car alarm in the parking lot. Ryan was shy and avoided interaction with peers except when prompted to engage by an adult. Ryan could imitate sounds and movements after receiving coaching. He had abnormal emotional responses to situations, as he would cry when it was not appropriate and angered easily.

Cody (pseudonym) was a six-year-old, Hispanic boy. His CARS-2 score was 18.5, indicating minimal to no symptoms of ASD. According to data from the CARS-2, his intellectual functioning was reported to be normal and consistent across different areas. He could follow multistep directions in English, though he is also a Spanish speaker. Also, data from the CARS-2 suggested that Cody demonstrated typical listening responses in class, as well as appropriate imitation of words and movements. He showed no difficulty in relating to others, and often displayed sympathy and concern for peers and adults. He would occasionally show an abnormal emotional response of crying when he was told to do something he found undesirable by an adult.

### **Setting**

This study was conducted at a private school for students with ASD. Each session occurred in the participants' classroom setting. Three participants were in one classroom, and one participant was in another classroom, determined by their ages. Jacob, Ryan, and

Cody were in classroom of eight students, and Claire was in a classroom of 10 students. Sessions occurred during academic subjects when the participants experienced the most difficulty attending, according to teacher report and pre-baseline observations conducted by the researcher. For all participants, these subjects were math and language arts. As a result of the school's winter break schedule and the absence of Jacob, Cody, and Ryan's teacher, there was a four-week break that began after the second week of the study.

### **Materials**

The following materials were used in this study:

#### **IRB Approval Forms**

Approval to conduct this study was obtained from FIU prior to the start of the study. The researcher followed FIU's IRB protocols for recruiting, consenting, and assenting participants.

#### **Parental Consent Forms**

Parents of each participant were provided with a parental consent form. This form included all information required by the FIU IRB.

#### **Participant Assent Forms**

Each participant was given an opportunity to assent once his or her parent signed the parental consent form. Since participants could not read or understand the written assent form, as told to the researcher by their parents, they were read the approved child verbal assent form by the researcher, and then gave their verbal assent. The form included all required information according to the FIU IRB policies and procedures.

## **Interobserver Agreement and Treatment Fidelity Forms**

Interobserver Agreement (IOA) forms and Treatment Fidelity (TF) forms were designed by the researcher and completed by the researcher and additional observer. The IOA data were taken to assess the reliability of the data collection system. The TF data assessed how well the steps outlined in the study design were followed (Gast, 2010; Richards, Taylor, & Ramasamy, 2014).

## **Data Collection Forms**

Momentary time sampling data sheets were used as data collection forms for the current study. One data sheet was used per session. Momentary time sampling data was used since the behavior being studied was not discrete and could be continuous.

## **Technology**

This study relied on technology to deliver verbal feedback to participants. The researcher provided all necessary equipment. Each participant wore separate earpieces, which were cleaned after each session using a sanitary wipe. The study was conducted using a two-way radio and ear bud instead of a cell phone and ear bud due to security and reception concerns.

**Two-way radio with ear bud speaker.** Each participant wore an ear bud speaker that was connected to a two-way radio, which the researcher used to communicate with the participant. The two-way radios were manufactured by Midland (model number LXT500VP3), and each earpiece was a G Shape Clip-Ear Headset Earpiece by GoodQbuy.



## **Independent and Dependent Variables**

The independent variables for this study were the verbal consequence statements delivered via CAC. Supportive and corrective statements were given to the participants. The dependent variable for all participants was attending, which was defined after the researcher conducted pre-baseline observations and consulted with the classroom teachers. For the purposes of the study, attending behavior was defined as: eyes looking at teacher/work/student who is sharing, feet on floor/still, still body, hands resting on desk, sitting upright in chair, sitting/facing forward in chair, head up, head facing direction of teacher/work/student who is sharing, quiet mouth and body. The classroom skill of attending has been defined in the literature as being part of a larger group of skills that are “necessary for learning to take place in a classroom” (Koegel & Rincover, 1974, p. 46).

Each verbalization given by the researcher to the participant corresponded with the target behavior. For example, if the participant was not attending to the teacher, the researcher delivered a corrective statement like, “Remember to look at your teacher” to encourage future occurrences of the behavior. If the participant was attending to the teacher, the researcher delivered a praise statement such as, “Great job looking.” These coaching statements have been found to be most effective when they are short as opposed to lengthy explanations (Goodman, Brady, Duffy, Scott, & Pollard, 2008).

## **Data Collection System**

Momentary time sampling data were collected during baseline, intervention, and maintenance sessions. In using momentary time sampling, the observation session was broken into equal intervals. At the end of each interval, the researcher observed for that

moment whether the behavior was occurring or not. The researcher marked a plus (+) sign on the data sheet if the behavior was occurring and a minus (-) sign if the behavior was not occurring. Intervals were established by observing the participants' behavior and their classroom schedules, and were set at a length that matched the frequency of their behavior and would not interrupt the flow of the classroom for the participants, their teachers, or their peers.

Observation times for baseline, intervention, and maintenance were determined once an initial observation of attending had been conducted. The length of intervals (one minute) and sessions (15 minutes) for participants were the same, and were determined during pre-baseline assessment of the target behavior.

### **Experimental Design and Rationale**

A single subject design (SSD) was used in this study. Single subject design research is a “quantitative method of scientific inquiry” (Bennett, 2016, p. 20) that is commonly used in applied research. In SSD, each participant serves as their own control, making the individual participants the focus of the effectiveness of an intervention, rather than a large whole group. By examining data on an individual level, it is possible for researchers to determine responders and non-responders to interventions (Bennett, 2016). Another advantage to using SSD is that it is appropriate to use to examine research questions among heterogeneous populations with low-incidence disabilities (e.g., ASD), and in applied settings (e.g., classrooms). When conducted properly, SSD allows for researchers to demonstrate high levels of internal validity. One disadvantage of SSD is the limited external validity that is achieved with one study. This issue, however, is resolved through direct and systematic replications of the original study (Bennett, 2016).

A multiple probe design, which was used in this study, is an example of an SSD that can be useful in showing a functional relationship between the intervention and the skill being addressed. In this design, the same behavior emitted by multiple participants is selected to target (Gast, 2010). The design contained three conditions including baseline, CAC, and maintenance. Baseline data were collected on attending behavior for a given participant for a minimum of 3-5 sessions where there is evidence of stability. For the current study, stability was met when 80% of the data fell within 20% of median for at least 3-5 sessions (Gast, 2010). Covert audio coaching was implemented with the most stable baseline tier while the remaining participants stayed in the baseline probe condition. These baseline probes were conducted every three sessions or more if stability was not evident. Additionally, baseline probes were conducted at a minimum of one - three sessions immediately before CAC was introduced to that tier. Once the first participant met the stability criteria during the CAC condition, CAC was applied to the second participant having met the baseline stability requirement. This repeated for the remaining participants. Finally, maintenance data were collected during probe sessions for each participant at weekly intervals for four weeks (except for one participant who only received three probe sessions due to leaving the school) following the conclusion of CAC.

A single subject design was used because it allows the researcher to repeatedly monitor progress over the course of the study. The multiple probe design across participants permits the evaluation and demonstration of inter-subject replication, which can increase the internal and external validity of a study (Gast, 2010). The design does not require the removal and reintroduction of the intervention thus avoiding the ethical

concerns that arise when doing so. Additionally, multiple probe designs are a practical way to measure functional skills that are nonreversible once they are learned (Gast, 2010). As with the classroom skill that was targeted in this study, once participants have the skill in their repertoires, it is unlikely that they will stop emitting the skill during the timeframe of the study. Therefore, a multiple probe design was the best fit for the purpose of this study.

## **Procedure**

### **Participant Selection**

The researcher obtained permission from FIU and the school principal to conduct this study. First, the study was submitted to FIU's IRB for approval. Once IRB approval had been obtained from FIU, the researcher met with the school principal and obtained a letter from her that stated the study could be conducted at her school. Once permission was obtained at these levels, the researcher began recruiting participants. To recruit participants, the researcher distributed an informational flyer (approved by the FIU IRB) to select teachers. Once teachers agreed to have the study conducted in their classrooms, teachers distributed the flyer to potential participants' parents. The flyer contained the researchers' contact information to give parents the opportunity to learn more about the study or to indicate their willingness to have their child participate. For those parents who indicated that they were interested, a consent meeting was held between the researcher and the potential participants' parents. Participants were selected using the following criteria: (a) the participant had a primary diagnosis of ASD, (b), the participant demonstrated difficulty attending, (c) the participant had adequate receptive and expressive language abilities, and (d) the participant did not have any hearing issues.

Information was obtained by asking the parents during the consent meeting. Parents were told that participants' identities would remain private and confidential in any reports or presentations. Once parental consent was obtained, child assent was obtained. The researcher recruited five participants for this study and, ultimately, included four, which is a suggested number of participants for a single subject design study like multiple probe (Gast, 2010).

### **Technology Training**

The purpose of the study and the use of the earpiece device were explained to the participants in a way that they could understand. Participants were then introduced to the equipment. They may have already known how to use the devices and felt comfortable wearing the earpiece; however, they were still exposed to it prior to the start of the study. It was important that the participants were instructed about and practiced what to do if the technology malfunctioned. They were instructed by the researcher on how to adjust volume and how to communicate to the researcher if something was wrong with their earpiece (such as making eye contact with the researcher and pointing to their ear) so that the session did not continue if the participant was unable to receive the prompts. Once the participants were familiar with the technology and had enough practice using it properly, the study began.

### **Multiple Probe Design (Conditions) Across Participants**

#### **Pre-Baseline**

During pre-baseline, the researcher observed each participant's classroom and observed them engaging in the target behavior for six days. Observations were done, in part, to mitigate participant reactivity to the researcher. The researcher took anecdotal

notes at first, and then began to take momentary time sampling data on attending behavior. If the participant was found to be attending an average of 60% or less of the time, they qualified for participation in the study.

### **Baseline**

During baseline, the researcher was at the side of the participant's classroom and collected data on the target behavior. The researcher had two to four separate observation sessions (i.e., multiple sessions that are each 15 minutes in length) during a given day, depending on the availability of the participant due to therapy schedules or absences. Each participant had three sessions per week, and only one session per day. During the determined timeframe of the baseline sessions, 15 minutes, the researcher took data on attending behavior using the momentary time sampling data collection form. The researcher did not interact with the participant at all, and the CAC equipment was not available.

### **Intervention**

Intervention sessions, that were also 15 minutes in length, involved the researcher sitting in the classroom using CAC equipment, and the participant at their desk or assigned classroom spot wearing an earpiece device that was connected to a two-way radio. Before each intervention session, the researcher conducted a sound check with the teacher to make sure the volume was not too loud. The researcher asked each participant if the earpiece was comfortable, if the volume was too high or too low, and if they still wanted to participate. When the participant said yes, the session began. The researcher reminded the participant of his or her responsibility to inform the researcher if any issues arose with the technology. At the end of each interval (i.e., every minute of the session),

the researcher looked at the participant to see if they were engaging in the target behavior. If, at that moment, the participant was attending, the researcher delivered a praise statement such as, “Good job looking.” If, at that moment, the participant was not attending, the researcher delivered a corrective statement such as, “Look at your teacher.” The researcher simultaneously took data on target behaviors as well as frequency and type of coaching statements that were delivered. Intervention conditions were the same for each participant.

### **Maintenance**

Maintenance conditions were identical to baseline conditions in that the participant was neither wearing an earpiece nor had any interaction with the researcher. The researcher was in the classroom collecting data on the target behavior during the maintenance sessions. Maintenance sessions occurred for each participant at weekly intervals for four weeks after the conclusion of CAC, except for one participant who only received three maintenance sessions.

### **Interobserver Agreement (IOA) and Treatment Fidelity (TF)**

The IOA data involved the researcher and an additional independent observer collecting data on the target behavior at the same time. The collection of IOA data ensures that no observer drift occurs throughout the intervention, that data collection is objective, and that data are being collected according to the definitions and recording procedures established prior to the start of the study (Gast, 2010; Richards et al., 2014). The IOA data were collected during 37.2% of baseline sessions, 34.6% of intervention sessions, and 46.7% of maintenance sessions. The formula for calculating IOA was: number of agreements divided by the number of agreements and disagreements

multiplied by 100 (Gast, 2010; Richards et al., 2014). The goal of IOA is to have 80% agreement between both data collectors at a minimum (Gast, 2010; Richards et al., 2014). For the present study, an IOA of 90% was the goal.

The same independent observer recorded data for TF during 37% of baseline sessions, 35% of sessions, and 46% of maintenance sessions. The TF data are taken to increase the likelihood of proper implementation of the study's design. While the researcher conducted selected sessions with participants, the additional observer scored a plus sign (+) when a planned researcher behavior was observed and scored a minus sign (-) when a researcher behavior could have occurred but did not, or if a researcher behavior was implemented incorrectly. TF was calculated by dividing the number of observed behaviors by the number of planned behaviors and then multiplying by 100 (Gast, 2010). The minimum TF data for this study was 90%, and the goal was to be as close to 100% as possible.

The independent observer was trained by the researcher prior to the start of the study for both IOA and TF. The observer was a graduate student at FIU who volunteered to participate in the study in this capacity. The observer was instructed by the researcher as to where they were to sit in the classroom and how much interaction they were to have with participants and the researcher during sessions. The researcher explained the target behavior and its definition, which was written in observable and measurable terms. The researcher reviewed IOA and TF forms with the observer and then practiced taking IOA and TF data together before baseline sessions. The researcher checked the IOA practice data, and once 90% accuracy of the recording procedures had been achieved over three



observation periods (Gast, 2010), the observer was deemed adequately trained to begin collecting study data.

### **Social Validity**

Social validity refers to the extent to which the dependent variable is considered socially important (Gast, 2010). To measure social validity, the researcher met with the participants after the study had concluded and asked them questions about their experience. The researcher met with participants individually, and participants' responses were recorded on the social validity data sheet.

Social validity data for participants were grouped together, and the frequency and percentage of responses were analyzed. The researcher asked the participants questions regarding their preference using the earpiece device, receiving feedback in class, and how they believe the intervention affected their engagement in target behavior. Examples of such questions are: (a) did you like wearing the earpiece device? (b) how did it feel having someone talk to you about what you were doing? and (c) do you think your behavior changed because of the coaching you received? The researcher also asked the participants if they would like the opportunity to use CAC in other aspects of their school or home life (see Appendix D).

Additionally, the researcher met with the participants' teachers to have a similar conversation about their impressions of the study. Teachers' perspectives were collected because they are considered individuals who are affected by the intervention (Wolfe, 1978). The researcher asked them questions about the demeanor, participation, and engagement in target behavior of the participants. Examples of such questions are: (a) did the participant seem distracted during sessions? (b) did you notice a difference in the

participant's behavior? and (c) did you see other students in the classroom notice that the participant was wearing an earpiece or receiving coaching? The researcher had met with the teachers prior to the study to help determine and define the target behavior, and therefore, their feedback on the instances of behavior were especially important. The researcher used similar definitions and terms such as "ready hands" during the study so that the target behavior was relevant to the classroom environment. Finally, the researcher asked teachers about whether they would like to see CAC used to address other target behaviors for students (see Appendix E). Neither the participants nor the teachers were shown the results of the study prior to these meetings so that the results did not influence their feedback.

The information gleaned from these conversations may prove to be helpful anecdotal data for the current study. The information may be beneficial when designing future studies that use the same intervention, environment, target behaviors, or profile of participants.

### **Data Analysis**

Data were taken continuously for each participant and plotted on line graphs. The researcher observed each participant's patterns of behavior individually. The researcher analyzed the level, trend, variability, immediacy of effect, consistency of data across similar conditions, and overlap of the participants' data paths by conducting a visual analysis (Cooper et al., 2007; Richards et al., 2014). Additionally, the researcher analyzed the mean for each condition (probe and intervention) to look for differences between the data paths.

## **Summary**

The current study investigated the effectiveness of covert audio coaching on increasing the instances of the attending behavior of students with ASD in the classroom. Statements to address the target behavior were delivered by the researcher via CAC technology. Parental consent and participant assent was obtained prior to the start of the study. Using a multiple probe across participants design, this study examined the effects of CAC on increasing instances of attending behavior of participants. A visual analysis of data paths was conducted to determine what, if any, effect the independent variable had on the dependent variable (Gast, 2010).

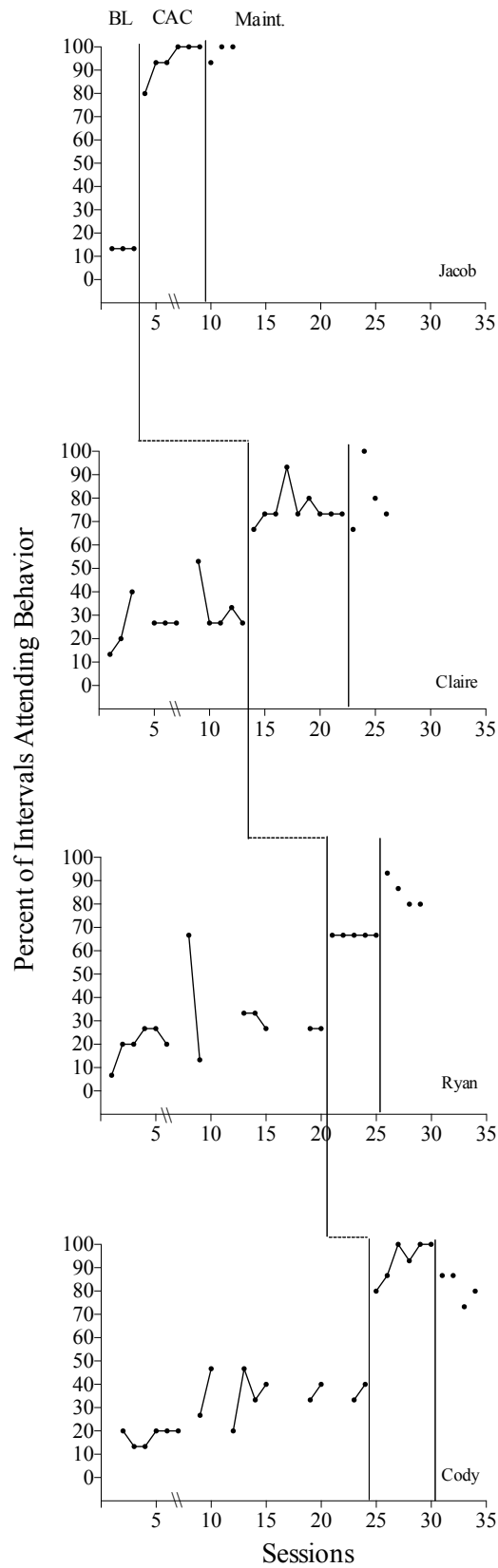
## CHAPTER IV

### RESULTS

This chapter details the results of a multiple probe across participants study that explored the use of Covert Audio Coaching (CAC) on the instances of attending behavior of four elementary school students with Autism Spectrum Disorder (ASD). There were three conditions used in this study: (a) baseline, (b) intervention, and (c) maintenance. The dependent variable was instances of attending behavior. The independent variables were the praise and corrective statements delivered to participants via CAC. Sessions were 15 minutes in length, and data were taken at intervals of 60 seconds. At the same interval during the treatment condition, praise or correction statements were delivered to participants via a two-way radio and earpiece depending on the observed behavior.

Overall, participants increased their instances of attending during the CAC intervention and maintained higher levels of attending than baseline during maintenance sessions. For each participant, there were differences between baseline and intervention, and for three participants, that difference was substantial. Figure 1 displays participants' instances of attending during the conditions of the study. Percent of intervals of attending behavior is presented on the y-axis and sessions are presented on the x-axis (see Figure 1).

Figure 1. Percent of intervals of attending behavior.



### **Interobserver Agreement**

The researcher and an additional observer collected point-by-point interobserver agreement (IOA) data (Cooper, Heron, & Heward, 2007). Baseline IOA data were collected for 36.4% of sessions and equaled 99.1% (range 93.3-100%). During intervention, IOA data were collected for 34% of sessions and equaled 99.3% (range 93.3-100%). Maintenance IOA data were collected for 46.7% of sessions and equaled 100% (range 100-100%). IOA was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100.

### **Treatment Fidelity**

The researcher and additional observer collected treatment fidelity (TF) data for 38.1% of sessions. Total TF across conditions equaled 100% (range 100-100%) and was calculated by dividing the number of observed researcher behaviors by the number of planned researcher behaviors and multiplying by 100 (Gast, 2010). Treatment fidelity data were collected for 36.4% of sessions during baseline and equaled 100% (range 100-100%). During intervention, TF data were collected for 34% of sessions and equaled 100% (range 100-100%). Finally, TF data were collected for 46.7% of sessions during maintenance and equaled 100% (range 100-100%).

### **Jacob**

Jacob was the first participant to receive the intervention, as his baseline data were the most stable. During baseline, his mean instance of attending behavior was 13.3% of intervals (range 13.3-13.3%) Since there was no variability (a zero-celerating trend) between these three sessions, the intervention was introduced. During treatment, his mean instance of attending behavior was 94.4% (range 80-100%). Jacob's data path

during treatment increased at a steady trend and leveled out at three sessions of 100% attending. The immediacy of effect for Jacob was very strong, with the final baseline probe being 13.3% attending and the first intervention session being 80% attending, showing an increase by a factor of six. There was no overlap between baseline probes and intervention data paths. There was also no overlap between maintenance and baseline probes. The average instance of attending behavior during maintenance was 97.7% (range 93-100%). Additionally, there was an ascending trend among these data points. Jacob only received three out of the planned four maintenance sessions because he switched schools before the final session occurred.

### **Claire**

Baseline data probes for Claire were the next most stable, and therefore, she received the intervention second. During baseline, her mean instance of attending behavior was 29.1% of intervals (range 13.3-53.3%). These data were variable, but the last four data points of that condition were stable. Her mean instance of attending behavior during intervention was 75.5% (range 66.7-93.3%). Claire's data path during intervention was somewhat variable but was steady around the mean for the last five data points of that condition. Moreover, her final three intervention sessions were all 73.3%. The immediacy of effect for Claire was similar to that of Jacob, in that her final baseline probe session was 26.8% and her first treatment session was 66.7%, which more than doubles the last baseline probe. There was no overlap between baseline probes and the intervention data path. The average instance of attending behavior during maintenance was 80% (range 66.7-100%). There was much variability during this condition, with no

clear trend of data points during the four sessions. The mean, however, was higher than the previous two conditions.

### **Ryan**

After three additional baseline probes, Ryan had the most stable baseline data of the remaining two participants. During baseline, his mean instance of attending behavior was 31.5% of intervals (range 6.7-66.7 %). The last five data points of this condition were stable with a slight descending trend. His data path during intervention was also stable with a zero-accelerating trend. All five intervention sessions were 66.7%. The immediacy of effect for Ryan was identical to that of Claire, as he went from 26.7% in his final baseline probe to 66.7% in his first intervention probe. There was only one instance of overlap between baseline probes and intervention data. During one baseline session, Ryan was found attending for 66.7% of intervals; however, that data point is an outlier. During that session, Ryan and his peers were standing around their cluster of desks working on a group activity for the same subject matter as other sessions. Ryan was standing, moving around, and talking, which were all behaviors that usually would be considered not attending, but in this instance they were acceptable for the activity and deemed as appropriate. The average instance of attending behavior during maintenance was 85% (range 80-93.3%), which is higher than the mean during baseline and intervention. The final two data points during maintenance were at 80%; however, there was a descending trend during this condition of the study.

### **Cody**

Cody received four additional baseline probes before stability was met and the researcher deemed him ready to receive treatment. During his 16 baseline sessions, his



mean instance of attending behavior was 29.2% of intervals (range 13.3-46.7 %). The last six baseline data points had a consistent pattern with a zero celerating trend. Cody received six intervention sessions, with the mean instance of attending behavior being 93.3% (range 80-100%). There was an initial ascending trend with stability of the last four data points of this condition. The immediacy of effect for Cody was strong, as he jumped from 40% to 80% between the final baseline probe and the first treatment session. There was no overlap between baseline probes and intervention data paths. The average instance of attending behavior during maintenance was 81.7% (range 73.3-86.7%). While his instances of attending decreased after the intervention was removed, the mean is still substantially higher than the baseline mean.

### **Social Validity**

When the study concluded, the researcher met with participants and teachers individually to ask them questions about their experience. All four participants shared that they enjoyed using the CAC technology and that they felt it helped improve their classroom behavior. Additionally, they all stated that they would like to use the earpiece technology in the future and in other classes (See Appendix D). Both classroom teachers said that they enjoyed having the study conducted in their classroom and thought CAC had a lot of potential, but only one saw behavioral changes in her students (See Appendix E).

### **Participants**

**Jacob.** Jacob thoroughly enjoyed participating in this study. He said that wearing the earpiece was “so cool” and that his least favorite part of using the technology was having to take it off after each session and not being able to use it anymore. Jacob also

told the researcher that he preferred to receive feedback during class rather than after class because when it occurs after class, he has to miss physical education. Additionally, he said that he liked “hearing nice things” from the researcher about his behavior, and that he felt that the technology helped to improve his behavior because he was listening to what was being said.

**Claire.** Claire said that she felt “really neat” when she was wearing the earpiece because she liked using “a real life walkie talkie.” She indicated that she felt special while being coached, and that her favorite part of receiving CAC was hearing the researcher talk to her. She said that she disliked when the earpiece fell out, which happened a few times when she would move her head too fast or play with her hair. When this happened, the researcher would go over to her desk immediately and fix it. She said that she liked having someone watching her and talk to her about her behavior, but when asked if she felt her behavior changed as result of the study, she said “not really.” She indicated that she would be willing to wear the earpiece in a different class, but that she doesn’t believe she needs any more help regarding her behavior. Finally, she said she preferred being helped during class rather than after class because she “forgets things a lot of the time.”

**Ryan.** Ryan said that wearing the earpiece made him feel nice. He would turn around to see the researcher whenever he heard something. This happened only a few times in the beginning of the intervention when the participant would turn around and give a thumbs up while repeating the coaching statement that was just given (e.g., “good job”). He indicated that he liked being the only one wearing the earpiece, and that he liked being coached. His least favorite part was having to keep the two-way radio in his

desk. He told the researcher that he believed his behavior changed as a result of the CAC, although the researcher does not believe he understood the meaning of the question. He said he would like to wear the earpiece again and in different settings, and said that he likes receiving help both during and after class.

**Cody.** Cody said that he felt “like a secret agent” when he was wearing the earpiece. He said receiving coaching statements “felt like a game” to him, and that the best part of being coached was having the researcher compliment him. His least favorite part was not having the earpiece anymore, and he said he “loved” having someone watch him and give him feedback. He indicated that the CAC changed his behavior because he “did a good job almost always,” and he would like to wear the earpiece in some other classes. He would like to receive coaching on his anger issues, which he asked the researcher before the first session if that was the target behavior. When the researcher said no, he expressed his disappointment. Finally, Cody said that he likes receiving help all the time because he wants to “be the best student.”

### **Classroom Teachers**

The classroom teacher, who was the school principal at the time and took over teaching duties for the original classroom teacher when she went on medical leave, for Jake, Ryan, and Cody said that she thoroughly enjoyed having the researcher in the classroom and experiencing a study being conducted firsthand. She said that she saw an immediate change in the demeanor of all three students when the researcher came in the room, with Jacob and Cody being the most enthusiastic to have the researcher there and to wear the CAC equipment. She noticed a change in the behavior of all three students during intervention and maintenance conditions as well as after the intervention had been

removed and the researcher was not in the classroom. She did not think that the intervention or the presence of the researcher was distracting.

Claire's classroom teacher told the researcher that she did not see a difference in Claire's behavior during the study. She thought at the beginning of the study that Claire was distracted by the researcher's presence and would often look at the researcher to see what she was doing, but after a few weeks of the researcher being in the class, she no longer seemed distracted. Claire's teacher said the study was no more interruptive than when therapists come and leave the classroom, which happens consistently throughout the day. She did not think it interrupted her teaching either. She said that she liked how other students in the classroom started greeting the researcher and talking with her when she would be there conducting sessions, as it showed her that they were using social skills with an adult and establishing a relationship with the researcher. Claire's classroom teacher said that Claire needs "a lot of work" on many of her classroom skills, and was glad that the CAC intervention helped improve her behavior even if she could not tell that it had. She is interested in learning more about CAC and how she can use it in her classroom for some of her students, especially those with 1:1 paraprofessionals.

### **Summary**

This study was conducted to examine the effects of CAC on the attending behavior of elementary school students with ASD. This was done by measuring the percentage of intervals of attending behavior for all participants. The results of this study indicated that all participants increased attending behavior during CAC and maintained higher than baseline levels of attending once the intervention was removed for up to one month. Participants enjoyed participating in the intervention and especially enjoyed using

the CAC equipment. One classroom teacher said she saw positive improvements in her students' behavior during and after the intervention. Neither of the classroom teachers thought that the study or any of its components were interruptive or had a negative impact on their teaching. They also expressed an interest in learning more about how to conduct CAC and similar interventions in their classrooms in the future.

## **CHAPTER V**

### **DISCUSSION**

This chapter provides a discussion of the results of this study. This study analyzed the effects of covert audio coaching (CAC) on the attending behavior of four elementary school students with Autism Spectrum Disorder (ASD) in the classroom setting. The following research questions were asked:

1. Does the use of CAC increase the instances of attending in the classroom setting?
2. If improvements are made, to what extent will they be maintained (i.e., weekly intervals for four weeks) once the intervention and CAC equipment are removed?

Data were collected on the percentage of intervals of attending behavior per session. A multiple probe design across participants was used in this study. The three conditions were: (a) baseline, (b) intervention, and (c) maintenance. All participants showed an increase in instances of attending during the intervention condition. After the intervention was removed, all participants maintained mean levels of attending that were higher than their respective mean baseline levels.

#### **Findings Related to Research Question 1**

Each participant in this study increased his or her instances of attending during the CAC intervention, and they maintained higher levels of attending than baseline during the maintenance probes. Each participant demonstrated a difference in mean levels of attending between baseline and intervention conditions, and for one participant that difference was considerable (Jacob). During baseline, each participant demonstrated some attending behavior, meaning that the skills were already acquired. This is important to note, as the goal of this study was to focus on a classroom skill that participants

already could demonstrate, rather than teaching them a new skill (see Bennett et al., 2010). Participants had to be attending less than 60% of the time during pre-baseline sessions to qualify for the study. Aside from two outlying data points, all participants were attending less than 55% of the time during baseline sessions. This showed that while they knew how to attend to their work and their teacher, they were not able to do so consistently. The CAC intervention provided participants with an opportunity to be coached on the classroom skill of attending, which as the researcher observed during pre-baseline sessions, was not already being done.

The findings from this study add to the literature on CAC in several ways. CAC interventions have been shown to be successful for students with disabilities (Price, Martella, Marchand Martella, & Cleanthous, 2002; Scheeler, Congdon, & Stansbery 2010). Adolescents and adults with disabilities have also experienced success in job performance and occupational training as a result of CAC interventions (Bennett, Brady, Scott, Dukes, & Frain, 2010; Allen, Burke, Howard, Wallace, & Bowen, 2012; Bennett, Ramasamy, & Honsberger, 2013a, 2013b). While these studies all provide examples of individuals experiencing success as a result of CAC, as well as the classroom setting being a viable intervention setting, they do not focus on the classroom behavior of children with ASD.

However, other methods have been used to increase attending behavior among this population. Koegel and Rincover (1974) used one-to-one teaching sessions to teach various classroom skills including attending. While improvements were made during these sessions, no further learning occurred in the larger classroom setting. Holifield, Goodman, Hazelkorn, & Heflin (2010) increased the attending behavior of two students

with ASD in the classroom by introducing a self-monitoring checklist. In 2000, Bryan and Gast used graduated guidance and visual schedules to increase the on-task behavior of students with ASD. They found that desirable behavior increased as a result of the intervention package, but when the researchers checked for maintenance, the participants' on-task behaviors had returned to their original levels

It is important to note that this study showed that CAC can be effective for young children, as three of the participants in this study were six years old when they participated in the intervention. Additionally, the participants in this study included both boys and girls, as well as different grade levels (first grade and fifth grade).

### **Findings Related to Research Question 2**

The results from this study showed enduring results as evidenced by data collected during each participant's maintenance condition. All participants maintained levels of attending during maintenance that were higher than their respective baseline levels. With the exception of Jacob who only received three maintenance sessions, all participants maintained high levels of attending for up to five weeks after the CAC technology and coaching were removed. Jacob maintained high levels of attending for his three maintenance sessions. There was an initial decrease from 100% to 93.3% between the final intervention session and the first maintenance session. The final two maintenance sessions, however, showed 100% of intervals of attending. For Claire and Ryan, maintenance data were higher than intervention data, overall. Claire's maintenance data were unstable, though, with an initial ascending trend and then a steady decrease for the second half of the condition. Ryan's data were also unstable during the maintenance condition, with the first three sessions showing a descending trend from 93.3% to 80%,



and then the final two sessions remaining stable at 80% of intervals of attending. Cody's maintenance data were lower than intervention data overall, but still substantially higher than baseline. There was much variability during his maintenance condition, similar to Claire and Ryan. His first two maintenance sessions were at 86.7%, then decreasing to 73% before increasing to 80% of intervals of attending behavior during the final maintenance session. Cody's data are similar to those of another study that focused on increasing the attending behavior of students with ASD. In that study, Nicholson, Kehle, Bray, and Heest (2011) found that once their instruction was removed, the attending behavior of their participants with ASD decreased overall. However, Nicholson et al. (2011) reported that some students' attending behavior still remained above baseline levels. Results from past studies on increasing the attending behavior of students with ASD (not inclusive of CAC) were effective at increasing the desirable behavior; however, there are noted issues with maintenance. The same results can be seen in the extant literature on CAC in that some studies reported maintenance (e.g., Bennett, 2010), while another study reported difficulty with maintenance (i.e., Allen et al., 2012). The findings from the current study suggest that attending behavior maintained; however, there were mixed results among the participants in terms of variability.

Findings from studies that use CAC to assist individuals as well as from studies that examine the attending behavior of individuals with ASD have mixed results as a whole. While the studies mentioned above were able to increase the target behavior of the intended population, results were not always maintained once the intervention was removed. This inconsistency in behavior during maintenance conditions is problematic because of its implications for participants. The current study adhered to the Applied

Behavior Analysis (ABA) framework, which emphasizes the potential benefit for applied research. ABA interventions, including CAC, rely on their practical importance to be seen as effective (Baer, Wolf, & Risley 1968). This means that the benefit of a behavior change is best determined not by its contribution to theory, but by the people directly affected by the change. If the behavior is not maintained after the intervention is removed, it cannot be said that it was an effective intervention. The current study adds to the literature on CAC by providing an example of increasing a desirable behavior of children with ASD in the classroom setting, particularly one where high levels of attending, albeit somewhat variable, continued once the intervention was removed.

The variability between participants during the maintenance condition is similar to those found in other CAC studies. Allen et al. (2012) successfully taught participants with ASD target skills, but found that once the CAC intervention was removed, the instances of behavior decreased. The authors attributed this decrease to prompt-dependency of individuals with ASD (Allen et al., 2012). Bennett et al. (2010), however, found that high intervention levels maintained after the CAC intervention was removed. Bennett and colleagues' studies (2013a, 2013b), though not conducted in a classroom setting, used individuals with ASD as participants and found that results maintained for weeks after the CAC intervention was removed. The observed maintenance of the classroom skill of attending in the current study supports this finding of Bennett et al. (2013a, 2013b). It should be noted that the researcher observed that participants started receiving positive feedback from their teachers after the intervention was over, which could account for the observed maintenance results, although that is speculative and no data were collected on teacher behavior. One possibility for this increase in positive

feedback could be that the teachers were modeling the behavior that they observed from the researcher during the intervention condition.

### **Social Validity**

Social validity was measured to determine whether the intervention was seen as socially significant for the participants and their teachers (Gast, 2010). The three aspects of social validity according to Wolf (1978) are: the goals of the intervention, the procedures of the intervention, and the outcomes of the intervention. Each of these three aspects was addressed individually with participants and their teachers. All participants stated that they had a positive experience receiving the intervention, with Jacob and Cody expressing both excitement to participate and disappointment when the study was over. They also said that they believed receiving the CAC intervention changed their behavior in a positive way. Claire said it “didn’t really” affect her behavior, and Ryan said the intervention did change his behavior, although the researcher does not believe he understood the question. All four participants expressed that they would like to wear the earpiece again and in different educational settings. Additionally, they all said that they preferred to be helped during class rather than after class.

The CAC technology was appealing to all four participants, as they shared their excitement with the researcher before the first intervention session, with two participants expressing their excitement before and after every session, including during the researcher’s visits to the classroom during the maintenance condition. The two-way radio and earpiece were alluring to students because they knew about the technology but had never used it before. They are used to using certain technology like iPads and

headphones, but not two-way radios and earpieces that go in one ear only. Several of them commented on the “coolness” of using a “real walkie talkie.”

Determining the potential for CAC to be used in classrooms was the overarching goal of this study, and therefore, the classroom teachers’ perspectives were also gathered. The researcher spoke with Claire’s classroom teacher, and the school principal who had been filling in for the classroom teacher of Jacob, Ryan, and Cody since week three of the study when she left. Both teachers had a positive impression of the study as a whole, but only Jacob, Ryan, and Cody’s teacher said she saw a slight difference in her students’ behavior as a result of the intervention. Both teachers told the researcher prior to the start of the study that they thought that goal of increasing attending behavior was an important and appropriate goal for their students. They stated that their students needed help with many classroom skills, and that attending was one of them. Both teachers said that they would like to know more about CAC as they feel it could be beneficial to other students. Lastly, they did not think that having the study conducted in their classroom affected their teaching, the participants’ learning, or the other students’ learning.

### **Implications**

The results of this study have implications for students with ASD in the classroom setting. The results of this study suggested that CAC could be a useful tool in increasing the attending behavior of elementary students with ASD in the classroom setting. Since children with ASD miss many social cues due to their disability (Centelles, Assaiante, Etchegoyhen, Bouvard, & Schmitz, 2013; Chevallier, Huguet, Happé, Geiroge, & Conty, 2013; Gresham, 1984; Müller, Schuler, & Yates, 2008; Mandelberg et al., 2014; Rao,

Beidel, & Murray, 2008), an intervention that focuses on prompting appropriate behavior can be viewed as both socially and academically useful.

The maintenance data for participants shows that the effects of CAC can be prolonged after the intervention is removed. Current research that examines the maintenance of various target skills is inconsistent, when focusing on classroom skills of children with ASD (e.g., Koegel & Rincover, 1974; Bryan & Gast, 2008; Nicholson et al., 2011) and CAC as an intervention method for individuals with ASD (Allen et al., 2012; Bennett et al., 2013a, 2013b). This study found variability in maintenance results, as well. Though maintenance data were variable for Claire and Ryan, both Jacob and Cody showed fairly stable levels of attending during the maintenance condition. Additionally, all four participants maintained levels of attending that were significantly higher than baseline levels up to five weeks after receiving the intervention for the final time. Perhaps students, such as Claire and Ryan, could benefit from periodic booster sessions of CAC or they might benefit from coaching statements given naturally throughout classroom instruction but without the use of CAC equipment.

Pertaining to the learning styles of children with ASD, there is new research that challenges a common belief that children with ASD are predominantly visual learners (Earles, Carlson, & Bock, 1998; Kodak, Clements, & LeBlanc, 2013; Kozleski, 1991; Rao & Gagie, 2006) and have weak auditory learning channels (Azouz, Khalil, Abdou, & Sakr, 2014; Carpenter, Estrem, Crowell, & Edrisinha, 2014; Kellerman, Fan, & Gorman, 2005). This emerging literature suggests that children with ASD perform better on tasks that contain both visual and audio components (Erdódi, Lajiness-O'Neill, & Schmitt, 2013; Trembath, Vivanti, Iacono, & Dissanayake, 2015). It is important to note that CAC

in the current study involved an audio component without the use of visuals. This intervention, and the findings from this study, support the idea that some children with ASD, working on certain behaviors, can be successful when the intervention modality affects the auditory learning channel only. These participants scored between 16 and 32.5 on the CARS-2, which indicates minimal to moderate symptoms of ASD. Their listening response scores ranged from 1-3, indicating between age-appropriate listening responses and moderately abnormal listening responses. Additionally, their intellectual responses ranged from normal to mildly abnormal according to the CARS-2. These two categories are important to note because they are directly related to the CAC intervention. Participants were able to listen, respond, and understand what was being said to them. Had they scored in the severely abnormal range for either of these categories, perhaps they would not have responded to the coaching statements being delivered by the researcher. Professionals who are considering using CAC interventions should take these particular CARS-2 categories into consideration when selecting participants to make sure that participants are capable of benefitting from CAC.

The classroom skill of attending has been documented in the literature as a skill that is “necessary for learning to take place in a classroom” (Koegel & Rincover, 1974). This study demonstrated that instances of attending could be increased as a result of CAC. Furthermore, the operational definition of attending for the purpose of this study included, in part, looking at the teacher or individual who was speaking, which Sparapani, Morgan, Reinhardt, Schatschneider, and Wetherby (2015) say this population is less likely to do due to deficits in social awareness. The importance and display of the

classroom skill of attending is one that should be further explored in order to support students with ASD in the classroom.

Like the study by Price et al. (2002), this study was conducted in a classroom setting during instructional time. Treatment fidelity and social validity results from the current study show that the CAC intervention was able to be conducted without any significant disruptions to instruction, participants, peers, or teachers. Student teachers, classroom aides, co-teachers, and other school staff are examples of intervention agents who could conduct CAC sessions during instructional time.

### **Limitations**

There are several limitations to this study that must be considered when interpreting its results and implications. This study was conducted with four elementary students with ASD. It is unknown if similar results would be found with students with other disabilities or of other ages. It was also conducted with children who had mild to moderate symptoms of ASD according to their CARS-2 scores. Perhaps this intervention would not have been effective with children with moderate to severe symptoms of ASD, or those with developing receptive language skills. Additionally, only one classroom skill was targeted in this study. It cannot be said that CAC would be equally, or more effective, when targeting other classroom skills such as hand-raising or task completion.

Another limitation is that there was no equipment probe conducted prior to the start of the intervention. This could have mitigated reaction to the equipment as a potential contributor to the behavior change noted. This is potentially problematic because there were high levels of interest in the equipment as well as in participation for all participants. However, other CAC studies have included equipment probes and found

no reaction to the equipment itself among people with disabilities, including those with ASD (Price et al., 2002; Bennett et al. 2010; Bennett, Ramasamy, & Honsberger, 2013a, 2013b). Moreover, other researchers did not conduct equipment probes among individuals with disabilities participating in CAC interventions. For instance, Scheeler et al. (2010) conducted a five-minute training between baseline and intervention. However, equipment probes were not conducted during baseline to measure any potential reactivity to the CAC equipment. Allen et al. (2012) decided to switch earpieces after experiencing difficulty during pre-intervention training, but no equipment probes were conducted during baseline. Additionally, the observed high levels of attending in this study continued once the intervention was removed, possibly showing that the participants were not just reacting to the presence of the equipment. In sum, there are studies in the literature whereby baseline equipment probes were not conducted, and there are studies where the researchers included baseline equipment probes. In those studies where baseline equipment probes were conducted, the researchers found no reactivity among the participants. Nevertheless, it is important to note that the results from the current study are possibly due to an intervention treatment package, and the current data do not allow us to separate the individual components of that treatment package.

As an intervention package (i.e., equipment, praise, and corrective statements), this intervention was effective. However, we cannot separate out the possibility that students might have been motivated to perform due to the equipment or the presence of the researcher. Jacob and Cody expressed significant interest in receiving attention from the researcher. The attitudes and excitement of this study's participants could be because



they were much younger than participants in the aforementioned CAC study (Bennett et al., 2010; Bennett, Ramasamy, & Honsberger 2013a, 2013b).

Another potential limitation to this study was the extended absence of the classroom teacher of Jacob, Ryan, and Cody. During the third week of the study, the teacher took leave from the school unexpectedly and did not return for the rest of the school year. For the first two weeks of her absence, the class was merged with an older class and was taught by that classroom teacher. Due to the sudden change in environment, teacher, as well as curriculum, the study was suspended until after winter break, which lasted for three weeks. Then, students went back to their original classroom setting, with the principal filling in for the teacher. That arrangement remained throughout the rest of the study. There were no notable changes in behavior due to the change of the classroom teacher; therefore, the study resumed at that point. Nevertheless, this situation added another variable, which is the presence of the principal as the substitute teacher. This situation (having a substitute teacher present) is not uncommon in a school setting, and is an example of issues that can arise when conducting research in naturally occurring settings. Despite the prolonged gap between sessions, participants' data did not fluctuate, and the study was able to continue.

Finally, unlike the Price et al. (2002), study, the current study was not conducted in a general education classroom setting, but in a classroom at a private school for children with ASD. This is not, however, the most common setting for elementary students with ASD in the United States, as receiving pull-out instruction at a local public school is the setting where the overwhelming majority of this population is educated (U.S. Department of Education [USDOE]), 2015). However, the instructional methods

and design of the classrooms in this study are the same as common general education classroom settings, showing that CAC can be used in a naturally occurring setting such as the classroom and still produce improvements in behavior.

### **Suggestions for Future Research**

This study examined the potential of CAC to increase the attending behavior of elementary students with ASD in the classroom setting. These results have extended existing research and added to the list of potential target behaviors, settings, population ages, and population characteristics for which CAC can be useful. There are still ways in which the potential of CAC to assist students with ASD can be further explored. The following are suggestions for future research:

1. An examination of CAC with children with moderate to severe ASD;
2. A replication of this study using a larger sample size to determine what characteristics of participants with ASD are predictive of success with CAC;
3. A replication of this study using different sized earpieces, specifically ones made for children;
4. A replication of this study using Bluetooth technology and a wireless earpiece;
5. A replication of this study that includes booster sessions or fading strategies that do not involve CAC equipment;
6. Exploring the generalization of attending to other subjects and educational settings once the intervention has been removed;
7. An examination of CAC in a larger classroom where there are more students as well as in a general education classroom setting in a public school;

8. Exploring CAC with participants of different ages;
9. Exploring the possibility of interventions using a combined visual and audio modality as well as an audio only modality affecting the behaviors of students with ASD; and
10. A replication of this study focusing on different classroom skills.

### **Summary**

The results of this study suggest that CAC can be used to increase the instances of attending of elementary students with ASD in the classroom setting. In this study, students were given praise and corrective statements contingent upon their behavior via a two-way radio and earpiece. For all four participants, the intervention increased their instances of attending behavior, and mean levels of attending during maintenance probes were higher than mean levels of attending during baseline. Maintenance data, which were collected up until one month following the removal of the intervention, show that even after participants no longer are receiving coaching statements, the intervention as a package might have been affecting their behavior. A visual analysis of the data to determine mean, trend, and variability of data supports these findings.

This study supports existing literature on supporting children with ASD in the classroom as well as contributes to existing literature on CAC. The results of this study suggest that a combination of CAC technology, coaching statements delivered by a researcher, and the classroom setting contributed to an increase in attending behavior across participants. The range in age between participants as well as the inclusion of both genders adds to the population for whom CAC may benefit. Additionally, the Childhood

Autism Rating Scale-Second Edition (CARS-2) scores shows that this intervention can be successful when implemented with children with mild and moderate ASD.

Results from the social validity measure shows that participants enjoyed participating in the intervention, receiving feedback, and using the CAC technology. The two classroom teachers shared that they had a positive experience allowing the study to be conducted in their classroom and are interested in having CAC interventions done in their classrooms in the future. One teacher saw immediate and lasting results in terms of the participants' target behavior.

Findings from this study provide new information on how best to support children with ASD in the classroom. The findings also contribute to the literature in terms of how children with ASD learn, as well as specific classroom behaviors with which the population struggles. Teachers and school support staff should continue to focus on the teaching and reinforcement of classroom skills using evidence-based practices. With the presence of technology in modern classrooms, CAC can be used without stigmatizing the participants, and can also be used in a more discreet manner by using wireless earpieces and Bluetooth technology. The importance of classroom skills for students with ASD, particularly the skill of attending, combined with the mostly unexplored potential of CAC for this population, call for further studies similar to this one.

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APPENDIX A

DATA COLLECTION FORM: MOMENTARY TIME SAMPLING

## Momentary Time Sampling Data Sheet

Participant #: \_\_\_\_\_

Observer: \_\_\_\_\_

Target Behavior: Attending (eyes looking at teacher/work/student who is sharing, feet on floor/still, still body, hands resting on desk, sitting upright in chair, sitting/facing forward in chair, head up, head facing direction of teacher/work/student who is sharing, quiet mouth and body)

Date: \_\_\_/\_\_\_/\_\_\_

Start Time: \_\_\_\_\_

Subject/Activity: \_\_\_\_\_

Condition: \_\_\_\_\_

*Mark + if attending, - if not attending*

1	2	3	4	5

6	7	8	9	10

11	12	13	14	15

Comments:

APPENDIX B  
INTEROBSERVER AGREEMENT FORM

## Momentary Time Sampling Data Sheet

Participant #: _____	Observer: _____
Target Behavior: Attending (eyes looking at teacher/work/student who is sharing, feet on floor/still, still body, hands resting on desk, sitting upright in chair, sitting/facing forward in chair, head up, head facing direction of teacher/work/student who is sharing, quiet mouth and body)	
Date: ___/___/___	Start Time: _____
Subject/Activity: _____	Condition: _____

*Mark + if attending, - if not attending*

1	2	3	4	5

6	7	8	9	10

11	12	13	14	15

Comments:

IOA Formula:

Total # of Agreements \_\_\_ ÷ Total # of Disagreements and Agreements x by 100.

APPENDIX C  
TREATMENT FIDELITY FORM



## Treatment Fidelity Form

Completed by: \_\_\_\_\_  
 Participant ID: \_\_\_\_\_  
 Start Time: \_\_\_\_\_

Date: \_\_\_\_\_  
 Session: \_\_\_\_\_  
 End Time: \_\_\_\_\_

**Directions:** Score (+) for correct; score (-) for incorrect implementation of procedure.

<b>CAC Intervention</b>		<b>Implemented (+/-)</b>
1	CAC equipment turned on and volume turned up	
2	Timer turned on	
3	Researcher looks at participant(s) and records behavior at the end of each interval	
4	Researcher delivers praise statement if participant is attending at the end of each interval	
5	Researcher delivers corrective statement if participant is not attending at the end of each interval	
6	Researcher records type of performance feedback given	

Total steps correct: \_\_\_\_\_

% Treatment fidelity: \_\_\_\_\_

APPENDIX D

SOCIAL VALIDITY MEASURE: PARTICIPANTS

## **Social Validity Questions**

### **Participants**

1. How did you feel about wearing an earpiece?
2. How did you feel about being coached through an earpiece?
3. What did you like the best about using an earpiece?
4. What did you like the least about using an earpiece?
5. How did it feel to have someone watch you and then talk to you about what you were doing in class?
6. Do you think your behavior changed because of the coaching?
7. Would you like to wear the earpiece in other classes?
8. Would you like to receive coaching on other behaviors?
9. Do you prefer being helped during class or after class?

APPENDIX E

SOCIAL VALIDITY MEASURE: TEACHERS

## **Social Validity Questions**

### **Teachers**

1. Did the participant seem distracted during sessions?
2. Did you notice a difference in the participant's behavior?
3. Did you see other students in the classroom notice that the participant was wearing an earpiece and/or receiving coaching?
4. How did you feel teaching while sessions were occurring?
5. Would you want CAC to be used again in your classroom?

## VITA

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