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Peer-Mediated Interventions for Middle School Students with High-Functioning Autism

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Peer-Mediated Interventions for Middle School Students with High-Functioning Autism

A thesis submitted in partial fulfillment of the requirement
for the degree of Bachelor of Arts in the Department of Psychological Sciences from
The College of William and Mary

by

Katelyn Evon Birchfield

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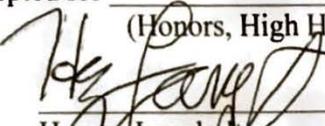
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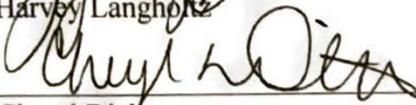
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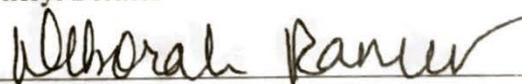
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Peer-Mediated Interventions for Middle School Students with High-Functioning Autism

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Abstract

Students with high-functioning autism in the general education setting may receive support in their academic development, though assistance in their social-emotional development and creation of relationships is little-to-nonexistent. In a population where social and communicative functioning is a primary deficit for labeling, it is critical that research develops evidence-based practices to support social growth. Peer-mediated interventions are a recognized practice in supporting students with severe disabilities and autism, particularly in their early elementary years and in high school (Bambara et al., 2016; Goldstein et al., 1991). The present study strove to find a connection between the utilization of peer-mediated interventions and the increase in social interactions while maintaining high levels of academic engagement for students with high-functioning autism in middle school general education classrooms. Three students with high-functioning autism were followed throughout the course of a one-semester intervention, and data were collected through use of a paper-and-pencil graphic organizer in parallel with a 15-second interval timing application. Following the course of intervention, researchers determined a strong link between peer-mediated intervention and increases in social interaction with continued high academic engagement, as demonstrated through use of visual analysis along with inferential statistics. Peer-mediated interventions may therefore be recognized and further researched as an evidence-based practice for students with less severe disabilities at the middle school level.

Keywords: autism, high-functioning autism, peer-mediated interventions, peer support arrangements, social supports, evidence-based practice, middle school, education, intervention, adolescence

Peer-Mediated Interventions for Middle School Students with High-Functioning Autism

Evidence-based practices (EBPs) are the cornerstone of the modern American educational system following the implementation of critical educational legislation, including No Child Left Behind (NCLB) in 2001, the Individuals with Disabilities Education Act (IDEA) in 2004, and the Every Student Succeeds Act (ESSA) in 2015. Such legislation requires that schools provide appropriate educational supports to access specific points of developmentally appropriate academic content throughout students' school careers (Cortiella, 2006; "Every Student Succeeds Act", 2019). Given the nature of diverse student needs in schools, utilization of specific, research-based practices to ensure students are properly supported in their learning and assessment of content is crucial. Implementation of these practices may be generalized to all students or individualized through focused interventions. Peer mediation provides an excellent method of both class-wide and individual EBP execution, as it requires the engagement of a broader community of peers and potentially adults to develop appropriate peer culture within the classroom (Bambara et al., 2016; Bowder et al., 2014; Carter et al., 2014; Sperry, Neitzel, & Engelhardt-Wells, 2010). Students are encouraged to engage in the curriculum while simultaneously developing interpersonal skills for social and communicative growth, in a manner that is individualized to their needs. Strategies of peer-mediated instruction have been beneficial in the socialization and academic achievement of all students involved, regardless of their potential disability status (Carter et al., 2014; McDonnell et al., 2001). Both students with disabilities, often referred to as the 'focus students', and typically developing peers tend to recognize an increase in their academic engagement and performance, along with the

development of new friendships and social skills in cooperation, empathy, and sharing (Bambara et al., 2016; Carter et al., 2014; Goldstein et al., 1991).

For students with communicative and social deficits, such as those with Autism Spectrum Disorder, peer-mediated interventions are often critical in the development of social skills. Autism encompasses a wide continuum of disabilities, with some individuals lacking verbal language or experiencing comorbid intellectual disabilities or other disabilities, while others are nearly typical in functioning, with average-to-high IQ scores and functional and behavioral skills. However, there are three primary deficits or deviations from the typically developing individual that are utilized as classifications for autism. Individuals with autism have difficulties in their social skills, communicative functioning, and repetitive or stereotyped behaviors. In socializing, individuals with autism may not recognize innate social cuing or socially appropriate behaviors and responses. They may also respond inappropriately in conversation, sometimes using speech that is classified as echolalic or scripted. Both echolalic and scripted speech are forms of non-authentic responding in which the student repeats back a previous expression. In echolalic speech, the student responds to the conversational partner with the same line of speech they just received, while scripted speech typically comes from movies and television, and may experience more of a lag between initial reception and later recitation. A final difference noted in individuals with autism is in their specific, repetitive, and fixated behaviors, in which they may develop obsessive behaviors related to pattern, orderliness, or some preferred skill, task, or object. Although the peer-mediated intervention does not explicitly target this third difference, students with HFA may have behavioral shifts as a result of continual positive role models in their proximity (Downing, Hanreddy, & Peckham-Hardin, 2015; Jackson, Ryndak, & Wehmeyer, 2008; Ochs et al., 2001). The peer-mediated intervention's primary purpose;

however, remains to be in its increase in appropriate social and communicative behaviors (Bambara et al., 2016).

Prior research indicates the effectiveness of peer-mediated interventions in increasing frequency and quality of interactions, enhancing connections between students with disabilities and typically developing peers, building communication and social skills, and developing new friendships (Carter et al., 2014). These positive effects impact all students involved in the intervention, as typically developing peers establish a better understanding of disabilities, and gain efficacy in differing styles of interaction, as well as gaining new social connections ("Evidence-based practices and Autism in schools", 2009).

Not only are these peer connections imperative to the understanding of the social world and communication abilities, they serve as important protective factors for students with disabilities. Children with social-skills deficits often face negative experiences of peer rejection, mental health problems, and school dropout, which may be preventable with the proper support from adults and peers (Petursdottir, McComas, McMaster, & Horner, 2007). Mental health problems become a significant dilemma for students with Autism Spectrum Disorder, many of whom report feelings of isolation and bullying, leading to symptomology of anxiety and depression (Carter et al., 2014). Estimates indicate that up to 40% of individuals with autism experience anxiety at a given time, with another 20% of the population with autism experiencing depression ("Mental health and autism", n.d.). Approximately 30-35% of the American population with learning disabilities alone present mental health afflictions, and this number only increases dramatically for students with intellectual disabilities and autism (Kim et al., 2000). However, these symptoms of mental illness often go unnoticed and untreated, as the students have few friendships and intimate connections to notice the problematic presentations (Lake,

Perry, Lunsky, 2014). Students may also have difficulty presenting their negative affect and feelings as a result of hindered communication, or a deficit in verbal-linguistic skills. When students cannot voice their internal suffering, they are often disregarded into a quiet background, or reprimanded for their inappropriate behaviors without an analysis of the root of these problems. Therefore, young children with disabilities are four times as likely to develop mental health complications and are twice as likely to have suicidal thoughts or anxiety but have no mechanism to express their distress as a result of their isolation ("Mental health of those suffering with physical or learning disabilities", n.d.). Simply providing social support to students in need can reduce the risk of negative mental health outcomes or lessen their severity.

Social support is also critical in the development of healthy friendships, relationships, and social networks, which become an integral part of adult life (Hirsch & Rapkin, 1987). Understanding how to engage in these various relational contexts is often a weakness for students with developmental delays and Autism Spectrum Disorder and providing mediated practice in the controlled context can be immensely beneficial. Communicative and social functioning skills typically develop at a young age, and the more years a child experiences this lag in functioning, the greater their deficit appears (Boyd et al., 2010). Children with typical developmental trajectories are often considered more socially adept, arguably due to their participation in social environments such as the general education classroom, as well as extracurricular activities and sports that require the development of their social interactional skills. The exclusion of certain students from these interactions inhibits their development in the least restrictive environment, and hinders their ability to learn important social skills including requesting assistance, asking questions, maintaining conversation and eye contact, properly entering and exiting a conversation, problem solving and conflict mediation, etc. (Downing,

Hanreddy, & Pecham-Hardin, 2015). When students are explicitly instructed in these social functions, and then given opportunities for practice with peers, they begin to better understand proper methods for communicating and socializing with others. This allows for the theory of social constructivism by Piaget to become readily apparent, as students are able to learn from each other, not only in their communication and social skills, but in academic and cultural domains as well. Social constructivism can be further explained in the context of peer-mediation through the ideas of Lev Vygotsky, by indicating the importance of a more-skilled other in modeling proper behavior. In this instance, the typically developing peers serve as experts in the social world and peer culture, guiding students with disabilities into appropriate integration and allowing for interactions that assist both social and intellectual growth (Vygotskiĭ, Cole, Stein, & Sekula, 1978).

Academics also provide a bridge for developing this social, emotional, and intellectual growth. When students are of a similar age and studying similar topics in school, there is a stronger foundation for developing social and academic support through shared learning and also potential frustrations with difficult materials. Many classroom friendships develop out of conversations and questioning of difficult materials, and typically developing peers tend to rely upon friendships and social networks both to learn content and complete assignments, and to express their frustrations and cognitive strain in certain coursework (Hamm & Faircloth, 2005). Meanwhile, students with disabilities or students experiencing increased levels of isolation in their classrooms may feel that they are alone in their struggles, that their difficulty in assignment completion and understanding course materials is entirely unique and they are somehow less worthy or cognitively proficient. The development of friendships and social networks is imperative to the support of the student's self-esteem and content knowledge, as they can then

discuss their concerns and difficulties with peers and share mutual complaints. Although these

expressions of dissatisfaction are seemingly negative, they embrace an overall positive shared

experience as the focus student and typically developing peer engage in a mutual exchange of

emotion. These learned behaviors benefit students in their understanding of emotional integration

and expression in the social realm. In addition, students involved in these peer-mediation

strategies have an opportunity to learn from each other, to ask questions, and to further their

understanding of content. It is typically encouraged that these positive interactions occur at

regular, frequent intervals, making the 60-minute daily class session of the middle school

environment ideal (Bambara et al., 2016). For generalizability to exist, it is critical that these

peers engage with the student with disabilities over an extended period of time, and preferably on

a daily basis to establish some routine. Despite the importance of routine, differentiation in the

trained peers may also be beneficial. Incorporating multiple students in the intervention creates a

heightened ability for generalization, as students with autism learn to widely apply social and

communicative skills across individuals and settings. Generalization also can occur from the peer

perspective, with peers not trained in peer-mediated interventions also indicating higher levels of

involvement with children with disabilities when engaged with the peer mediator, also referred to

as the peer support. The peer support plays a critical role in modeling socially appropriate and

friendly behaviors both for other typically developing peers and the student with a disability

(Rogers, 2000).

Incorporation of all peers in the intervention is the penultimate goal of peer-mediated

interventions, as this allows for autonomous generalizability outside of the context of adult

facilitation. Therefore, the most successful peer-mediated interventions that allow for completely

peer-initiated conversation, so that adults are largely removed from the social realm. In the

classroom and early in social interventions, 30-40% of social interactions occurring between the children in their peer-initiation study begin with a teacher-prompted peer social initiation. Simply the presence of a teacher in the room may remind peers to engage with their assigned buddies in the classroom. Providing generalizability to the extent that these behaviors can occur without teacher stimuli is critical to the development of friendships and social support outside the classroom, in extracurricular activities and the community (Odom, 1991).

Most studies currently emphasize intervention in the controlled classroom setting, including strategies for play organizing, sharing, helping, and giving affection and praise, with the hope that these will then extend beyond the realm of educator supervision (Rogers, 2000). These interventions include training that occurs across the series of multiple days, as well as daily sessions with the student with the disability. Training is typically taught by a teacher or professional in the school environment to specific students who have been identified as sociable, responsible, and in regular attendance. The intervention itself is then conducted by these students in cooperation with the teacher and other adult facilitators, who may prompt interaction when it is not readily evident following the commencement of the regulated social activity (Bambara, 2016; Huber & Carter, 2018).

Unfortunately, this interposition by teachers may establish a reliance on adult incorporation in the social interaction, providing a less positive, or at least less authentic, outcome. This serves as the primary limitation of peer-mediated interventions, as adult intervention inhibits the inherent autonomy peer-mediated interventions are supposed to promote. When students become reliant upon the adult facilitation, they are unable to incorporate these strategies in contexts where adults are not present or may forget to conduct the interventions altogether. This is typically seen in studies that utilize an ABAB or other repeating

design, in which the students are tested first at baseline, then with training and intervention, and are then returned to a baseline status to compare the effectiveness of the intervention. When returned to the second baseline, it is typically indicated that social interactions and communications decrease among students, particularly those who are reliant upon external contingencies and rewards from teachers (Goldstein et al., 1992; Odom, 1991). Those students that begin utilizing self-management and self-reinforcing techniques indicate more positive outcomes in the continuation of socialization outside the scaffolded intervention. Providing a gradual phasing of adult prompting out of the social sphere during independent or group work time, as conducted in the present study, provides more time for authentic conversational growth and greater potential for generalizability across settings.

Overall, literature in the domain of social interventions indicate peer-mediated intervention strategies as among the most efficacious and valid practices at all stages of development, with studies indicating success in students as young as preschool and then carrying throughout their high school years. Preschool research informs educators that training peers to initiate normal interactions at higher rates, including those that simply maintained an activity, created a greater rate of response than novel ideas (Goldstein et al., 1991). Prompting for such initiations and continuation of interactions should be supported by adults with fading cues over time to elicit long-lasting utilization and positive outcomes (Odom et al., 1991). By the time students reach the high school level, these adult cues must be faded to as minimal an intervention as possible. This provides a method and motivation for students to begin proper transitioning into the adult world, in which facilitation by a teacher or other adult is not always possible. Peer-mediated interventions have proven equally effective in high school students, in which peers are trained and then left largely to their autonomous decision-making skills in working with students

with disabilities (Bambara et al., 2016). Following a brief training alongside adults, peers

became the dominant facilitators of intervention, engaging in conversations over the course of

the 30-minute lunch period. Results of the study indicated that not only did social behaviors and

communication increase between typically developing students and students with disabilities, but

social validity was heightened. Social validity measures were determined through a brief survey

in which students indicated their attitudes toward each other and toward their participation in the

study. Both typically developing peers and those with disabilities indicated their appreciation of

involvement in the peer-mediated intervention, as it provided a new form of social support, as

well as a deeper understanding and respect for diversity in individuals and interactional styles

(Bambara et al., 2016).

        These studies, among numerous others, were conducted in a single-case design format, in

which researchers develop an in-depth study of only a select number of individuals. Although

formally referred to as single-case design, this line of research includes up to six participants.

Such research projects are considered valid and reliable in accordance with the American

Psychological Association, What Works Clearinghouse, and Council for Exceptional Children as

a method of studying conditions in which the general population does not meet the criteria

(Council for Exceptional Children, 2014; Georgoulakis, 2017; Kratochwill et al., 2012). Studies

utilizing the single-case design format are especially relevant in the field of special education,

where diverse disability labels, needs, and limitations create small sample pools from which to

conduct research and also to broaden application of studies. Given the 500% increase in school-

age children with autism in the United States from 1991-1992 to 1998-1999, special educators,

researchers, and advocates have mandated the necessity of single-case research to provide early

intervention and support to a growing population of need (Odom et al., 2003). However, single-

case design formats are also widely accepted and increasingly utilized in the fields of psychology (especially clinical psychology in research regarding psychotherapy and speech-language development), medicine, business, and industry (Hitchcock, Kratochwill, & Chezan, 2015; Kazdin, 2011). Examples of such studies demonstrating key research findings with small sample sizes in special education include work regarding self-monitoring of students with ADHD conducted by Wills and Mason in 2014 and a study of virtual manipulatives for students with learning disabilities at multiple baselines as conducted by Satsangi and Bouck (Maggin, Cook, & Cook, 2001). In addition, psychological and medical research regarding adult rumination behaviors in the setting of disordered eating (Thomas & Murray, 2016), cognitive-behavioral therapy for visual hallucinations (Thomson et al., 2017), and therapeutic practices for relieving chronic pain (Jones & Hurrell, 2018) have been conducted and validated in single-case design research.

In single-case design research, participants serve as their own measures of control, with researchers closely monitoring their behaviors and feelings during baseline and throughout intervention. Continual monitoring of levels of activity, trend of activity, variability versus consistency, overlap, and the immediacy of effects within and between conditions provide determination of the effectiveness of the intervention or treatment, regardless of the small sample size (Ledford, Lane, & Severini, 2018). Throughout the lengthy recording stage, average levels of interaction and engagement emerge, and any fluctuations become apparent. "The cornerstone of the most popular single case designs is the simple phase change," and it is this period that is not so quantitatively identified in simple case studies (Hayes, 1992). The phase change element "consists of (a) the establishment of stability, level, and trend within a series of data points across time, taken under similar conditions; (b) a change in the conditions impinging on the client and

(c) an examination of concomitant changes in the stability level of trend in a series of data points

taken under new conditions" (Hayes, 1992). This again allows for greater rates of control of

extraneous variables, as students are not impacted by some occurrence within the school at the

same time. By beginning intervention at varied points in time, researchers effectively determined

that there could not be another cause for any potential spikes in rates of activity. In single-case

design research, approximately 20 data points are collected per the 1-4 individuals involved to

create a broader sense of typical interactional rates (Shadish & Sullivan, 2008). In fact, meta-

analyses of 37 studies of evidence-based practices for students with autism found that the

average number of participants per study was only 2.84 students. These studies did typically

include other peers, as are found in peer-mediated interventions, but only 2-3 focus students were

studied across multiple baselines, typically with either a change from baseline to intervention or

the implementation and reversal of some alternative practice (Odom et al., 2003).

Single-case research is much more easily implemented for individuals at their specific

point of need given circumstances and identification as a member of an exceptional population.

Single-case methodology relies upon the use of repeated measurement, a degree of intra-client

reliability, specifications, replication, and an attitude of investigative play to ensure that adequate

research needs are met, and the study constitutes more than a case study review. In a simple case

study, researchers follow a specific individual to determine specific symptomology and

presentations of various thoughts, feelings, and behaviors, perhaps with some questioning and

determination of causality and ideas for change. Single-case research, on the other hand, utilizes

very specific research-based practices to ensure consistency and both internal and external

validity within and across studies. According to the National Academy of Sciences, scientific

research must consist of an empirical investigation, a linking of findings to a theory of practice,

the use of methods that permit direct investigation, a coherent chain of reasoning, and an ability to replicate and generalize across studies to ensure both reliability and validity at the external level (Odom et al., 2003). As single-case design research meets all of the above claims, it has been recognized as an accurate scientific practice for gathering data and making inferences regarding the needs of specific populations and best practices for providing critical accommodations. These inferences are determined through a visual analysis of graphed data to determine whether the data support a functional relation between the implementation of a specific intervention and the overall behavior of the participant. Visual analysis involves the examination of within-phase data patterns, comparing data patterns between adjacent phases for the individual participant, and considering the number of replications to understand external validity and the intervention effect (Maggin, Cook, & Cook, 2001). Single-case design research; therefore, often promotes the use of multiple studies to ensure the adequacy and effectiveness of an intervention. This is; however, simply a good practice in research, as no study should go without continual replication to ensure the reality and significance of results.

Given the strong support for single-case design studies, a similar methodology has been used in the present research. Single-case design is recognized as a predominant practice in the discovery of evidence-based practices for supporting students with autism. Peer-mediated interventions are a recognized evidence-based practice at the preschool and high school level as demonstrared through extensive development and replication of single-case studies. However, little is known about the intervention's functionality and effectiveness in the transitional years, particularly in middle school. There is a largely inexplicable gap in the research during these critical years of social and cognitive development, at a time in which all students, regardless of disability status, can benefit from training and support in their socialization, emotional

development, and academics. This is particularly true for students with high-functioning autism, who are spending increasingly large portions of their days in the general education setting. Since peer-mediated interventions work best in classroom settings where students are of a similar age and working on similar or identical content and assignments, the middle school setting with a population of students with high-functioning autism is a perfect candidate for a peer-mediated intervention. In the present study, researchers sought to determine the effectiveness of a peer-mediated intervention, also referred to as a peer-support arrangement, on the amount of social interactions occurring between students with high-functioning autism (HFA) and typically developing students. In addition, the researchers sought to determine the rate of peer academic support with peer-mediated interventions, with the goal of increasing academic awareness and engagement for all students. This led to a final goal of increasing or maintaining high rates of academic engagement throughout the class period, in addition to increased involvement in the social setting. Researchers believed that with appropriate training of the special educators, paraprofessionals, and peer supports, the peer-mediated interventions would create higher rates of social interactions, peer academic support through questioning, sharing notes, and reciprocal tutoring, and higher rates of academic engagement.

Method

Recruitment

The present study strove to validate previous research on peer-mediated interventions as an evidence-based practice for middle school students with high-functioning autism (HFA) in general education classrooms. After obtaining necessary documentation and approval from the Institutional Review Board at William & Mary and the local school district, researchers recruited a cluster of five middle school students with autism for the present study as focus students.

Students were initially recruited for participation via a recommendation from their special

education case managers. Informed parental consent and student assent was requested before

continuing with collection of confidential information. Once student recommendations and

consent were received, a brief meeting between special educators, administration, and the

research team was conducted, at which point all individualized education plans (IEPs) were

reviewed. To meet criteria for the present study, IEPs were required to indicate autism as the

primary student diagnosis, though some students did have secondary or multiple disabilities

listed. In addition, the IEPs indicated that students were being educated in the general education

setting with the assistance and support of a special education paraprofessional. Two students

were later withdrawn from the study, as one failed to meet research criteria and another withdrew

on long-term medical leave. Three participants remained a part of the study through the

completion of intervention, meeting the criteria for single-case design research, otherwise

referred to as small-n research.

        Once students were identified by their case managers, IEP and class schedules were

reviewed, classroom teachers and paraprofessionals were contacted to explain the purpose of the

present study, requirements of participation, identification of students, and compensation

specifications. General educators did not receive compensation for involvement as there were no

requirements for their participation beyond allowing researchers to sit in their classrooms.

Meanwhile, paraprofessionals received a $150 stipend for their involvement, given their more

extensive training and requirements. Their informed consent was then requested, and they were

asked for the names of other staff members who may offer relevant information about the class,

such as special education staff or other classroom teachers not previously contacted.

After a few weeks of data collection, more participants were pooled for involvement as trained peer supports, upon recommendation from general educators and paraprofessionals. Trained peer supports were other typically developing middle school students in the same classes as the focus students. These potential peer supports were identified to assist the student with HFA given their social adeptness, previous friendship or empathetic behaviors toward the student or student preference, and engagement in appropriate classroom behaviors. Although academic proficiency was not a requirement for the study, most students recruited as trained peers fell within the average or above-average range for grading criteria. Students were provided with informed assent forms and parental consent forms, which contained general information regarding the purposes of the study without revealing confidential information about the student with HFA. All but one peer returned consent and assent forms and were therefore eligible to participate in the research, leading to a support systems of two peers-per-focus student.

Participants

Individuals involved in the recruitment phase of research did not recommence involvement throughout the remainder of data collection. For example, the school board, principals, and special education case managers were critical in providing access to the school populations and recommendations for students meeting the needs-profile for the present research study. Once approval for the study and recommendations were received; however, their involvement was discontinued. The general educator also played a much more minimal role in the research study, as they were asked to maintain their typical demeanor, instructional practices, curriculum, and overall pedagogy throughout the remainder of the study. No adaptations or changes were made to their teaching format, beyond allowing involved peers to ask and answer questions of the student with HFA.

Involvement of the special education staff, namely paraprofessionals located in the classroom, was significantly more substantial. This involvement; however, faded throughout the course of intervention. Upon providing informed consent, the paraprofessional was observed conducting their normal instructional procedures and classroom behaviors at regular intervals for a few weeks. During this time, the paraprofessional or special educator was typically in close proximity to the student with HFA, leading to low rates of social interaction and peer academic support among students. They then attended a two-hour training session on peer-mediated interventions and supports and developed a peer support plan for the specific student. Next, they met with the general education teacher to appropriately select peers for participation in the study. Once consent was received from peer supports, the paraprofessional was responsible for leading a training session for these students to support the focus student and meet the focus student's goals. The focus student was not required to be present at this session, and they chose whether to reveal their identifying information to other peers. No students with HFA elected to attend their training session. During training, peer supports learned strategies for including seemingly isolated students in conversation and in academics. They problem-solved various situations in which they could facilitate an interaction, and practiced with some of these scripts. Once the training session was complete, intervention began. The paraprofessional continually provided support to the trained peers along with feedback on their interactions. Facilitative behaviors and feedback occurred with the greatest intensity at the beginning of the intervention and were then gradually faded unless requested by the students.

Students, therefore, were the primary participants and most actively involved individuals in the present study. Two primary groups of students were observed, the focus student with HFA and the peer supports trained to provide social and academic assistance. Other students were also

observed simply to collect inter-observer agreement (IOA) and to determine the amount and

quality of interactions with the focus student. The focus student alone was observed by the

research team at baseline for their initiations and responses to social cues with surrounding peers,

the quality and appropriateness of such interactions, their engagement with academic material for

the specific class, and their proximity to the paraprofessional. Behaviors of the focus student

were continually observed across baseline and intervention, with new variables for the peer

supports added. Interactions with peer supports, including initiations, responses, affect and

appropriateness of interaction, and academic support and involvement were then measured again.

Three focus students were followed throughout the entirety of the study, with two

students from the original five discontinuing participation due to changes in IEPs and special

educators available to conduct the intervention. Of the three remaining focus students, all were

enrolled in eighth grade content area courses in general education, with the assistance of a

paraprofessional or special educator. To maintain confidentiality and protect the identities of

these exceptional individuals, pseudonyms have been developed for reference. All individual

names referenced in this paper are entirely de-identified and constructed by the researcher, with

no ties to the students' true identities. Michael was observed during a morning algebra class,

which contained an average number of students, approximately 20 with some variance based on

absence, along with multiple push-in teachers as a result of other students with inappropriate

behaviors in the classroom. He had a primary label of autism spectrum disorder, with secondary

disabilities (though none serving as an impediment to cognition). Angela was observed during a

morning science class, which contained an average number of students, approximately 20 with

some variance dependent on student attendance, along with a general educator and

paraprofessional. She maintained a label for autism. Tanner was observed during an afternoon

science class with the same general educator, though a different paraprofessional for support. He

too had a primary diagnosis of autism, with no secondary disability specified. His science

classroom consisted of approximately 22 students, with some variance based on attendance rates.

Setting and Materials

All variables and participants were measured and observed in the general education

classroom during naturalistic observations. Each focus student was observed during a specific

class period where consent had been given by both the general education teacher and special

education paraprofessional. Two students were observed during an eighth-grade science class,

and one was observed during an algebra class. Baseline data were gathered for withdrawn

participants in seventh and eighth grade English, though intervention was not concluded. Each

class session was 60 minutes long, with data collection periods lasting a minimum of 40 minutes

in the midst of classroom activities and instruction.

These data were collected through a paper-and-pencil chart consisting of a series of

variables recorded each 15 seconds. Time was kept through a smartphone application

downloaded to each researcher's phone and synced across applications to ensure accuracy in data

recording. Once data were recorded, individual points were uploaded through the use of

encrypted files stored on locked computers into Microsoft Excel and eventually SPSS. All data

sheets were stored in a discreet, locked location to maintain participant confidentiality.

Measures

The student with HFA was observed throughout a multiple-month study both before and

during the intervention period. Intervention consisted of a change in peer dynamics through the

use of peer supports, in which specific socially adept individuals were selected to provide

academic and social support to the student with HFA. During this period of intervention, all

other variables were kept strictly consistent to ensure the validity of intervention in increased

academic and social interaction. Variables monitored for change from baseline to intervention

included focus student and peer initiations and responses, affect and appropriateness of

interactions, academic engagement and peer academic support, and proximity to peers and the

paraprofessional. These were tracked across 15-second intervals as both momentary time

samples and partial intervals. Initiations and responses from either the focus student or peer were

coded throughout the 15-second interval. Identified initiations were any attempt at

communication, including the use of another individual's name, asking a question, or making a

statement directly toward a specific person. Echolalic and scripted behaviors verbalized to no

target were not included as these are a characteristic of autism and not an indication of a

communicative attempt. Responses, then, were coded as any form of social engagement provided

in response to an initiation, including answering a question, responding with another question, or

potentially waving or giving a nonverbal communicative cue. In addition to tracking simply the

number of social interactions between students, peers, and later identified peer supports, affect

and appropriateness of interactions were coded. These were both identified on a three-point

scale. Affect was defined as positive, negative, or mixed. Positive interactions were those in

which individuals shared mutual feelings and expressions in sharing with one another, even those

including shared resentment (such as dislike of an assignment or teacher). Negative interactions,

meanwhile, were those that involved bullying, teasing, or other verbally aggressive and upsetting

behaviors. Mixed interactions included both positive and negative interactions, perhaps occurring

with different peers during the same interval. Appropriateness, meanwhile, was recorded in

congruence with behaviors and conversations that were socially appropriate for the student given

their age and level of maturity. Discussions that were age-appropriate sometimes included

content or language that was not considered school-appropriate but was typical for middle school

students at this phase of development. Inappropriate content; meanwhile, was any interaction that

was not considered developmentally appropriate, such as scripting from movies or talking

completely off-topic in the midst of conversation. At the end of each interval, student proximity

to other peers and the paraprofessional were coded to determine potential adult interference or

other extrinsic barriers to communication. All observations, coding, and analysis were conducted

by the three members of the research team.

Intervention

Systematic, planned training and intervention strategies were used with each

paraprofessional and involved students to ensure maximal validity across the process.

Additionally, each student began intervention at different phases while all other students

remained at their current level. This allowed for close monitoring for changes in behavior or

data, including any peaks or valleys in social interactions and academic engagement, which

could be indicators of extraneous variables. No significant indicators of a third variable were

found.

Each student's paraprofessional and peer support group went through an identical

training and preparation process before implementation of the support system. First, the

paraprofessional met with the research team to discuss candidacy of typically developing peers

for the study. The paraprofessional then met with the general education teacher for the identified

classroom and sent consent forms to students who were viable and appropriate candidates. Once

these consent forms returned, the paraprofessional formally met with the research team to learn

about the peer-mediated intervention and begin the development of a peer support plan. This

training began first with a debrief as to the study's primary purposes and aims, including access to all terminology and templates for paperwork used by the research team. The paraprofessional learned about each component of the study, its rates of effectiveness, and how it might apply in their classroom. They were encouraged to ask questions throughout the training.

Once a clear understanding of the general process was developed, the research team prompted the paraprofessional to think more specifically of the intervention's application for their specific student. Together, the team and teacher developed a peer support plan, including goals for the focus student both in the shorter and longer term. They created a list of strategies that the paraprofessional could use to support the student and peer supports, and a list of goals for the peer supports to work toward as well. These goals revolved around improvement in social interactions and academic engagements for all peers and were never considered so cumbersome as to lessen any student's education. Given these new goals and ideas, the paraprofessional was then equipped to explain this information to the peers in a much simpler format. Once trained, it would become the responsibility of the paraprofessional or special educator to bring together all peer supports, and potentially the focus student if they self-elected to be present, to discuss the plan.

At this meeting, the paraprofessional would give a vague description regarding an idea to increase social relationships and academics in the classroom. Each student selected would become a part of this project, and they would learn specific strategies to work with other students, especially those whom they noticed might need additional assistance or might desire a friend to work with during class assignments. The specific identifying information of the focus student would not be given unless the focus student asked that such information be revealed. After this brief meeting, seats in the classroom might be rearranged to place the peer supports in

closer proximity to the focus student. Then, class would continue as usual, with the general

educator providing their appropriate instructional content through their typical means and

strategies. The paraprofessional would continue their involvement in the classroom, though the

role began to shift. Now, the paraprofessional began to provide support to the peer support

group, rather than their assigned student. The paraprofessional asked prompting questions,

encouraged dialogue, and still answered academic questions and provided key content as

necessary to the focus student and their peer supports. However, over time they began to move

away from the peer support group as the students became more capable of maintaining its

success on their own. This created a more authentic social network as peers were able to interact

with the focus student without the interference of an adult presence. If the peer supports ever felt

they needed adult support; however, they could simply motion for the paraprofessional to return

and have additional contact with the adult. This peer-mediated support system was continued

throughout the course of the two-month study and beyond to the end of the public schooling

year, given its effectiveness and teacher and student buy-in to its validity.

 During this entire process, both through the baseline phases and interventions, three

researchers conducted observations for a minimum of 30 minutes on a 15-second partial interval

timer. A smartphone application was used to monitor this time, vibrating every fifteen seconds to

indicate whether observers were "on" or "off" in their data tracking. During the 15-second "on"

interval, researchers observed every social interaction and academic engagement the focus

student was involved in, and their relationship to their peers. Before implementing this

observation strategy in the classroom, all researchers were trained to 80% interobserver

reliability on a series of training videos. Researchers then trained in a live classroom setting with

randomized peer observations until 80% interobserver agreement was consistently obtained.

Data collection at baseline then began for all students, with researchers continuing to cross-check at least half of all data by having two researchers present at those observations.

Analysis

Data were analyzed via multiple technological formats, primarily in Microsoft Excel with some additional inferential statistics calculated through SPSS. All data were collected by hand using paper-and-pencil recording sheets across 15-second intervals and were then manually uploaded to a Microsoft Excel spreadsheet. Once contained within the spreadsheet, a second and sometimes third researcher verified all data entry to ensure high rates of accuracy in reporting. After all data were verified as correct, calculations were conducted within the Excel cells, creating output for means and variance for each participant, in each measure and category. These values were then adapted to fit a line graph, where they could most easily be read and interpreted.

Finally, to incorporate inferential statistics and broaden the application, a paired samples t-test was utilized to determine statistical significance. Data were transposed from the Microsoft Excel sheet into an SPSS sheet, where average values for the measures of interactions of students with disabilities, all peer interactions, all student interactions, and academic engagement were coded. These values were then placed into a calculator for paired samples to determine the likelihood that each result occurred as a result of intervention effectiveness rather than random chance.

Results

Figure 1 demonstrates the effectiveness of the peer support arrangements and interventions on the social interactions for the focus students. In addition to tracking social interaction, academic engagement and peer support were also recorded. Rates of academic engagement remained high throughout baseline and intervention for all students, while rates of social interaction showed a significant increase from a steady low line to a steady higher line.

Baseline interaction levels were very stable and consistently low across all three focus students involved in interventions. These interactional levels were below the normative rates of interaction in the classroom, as assessed through comparative peer analysis. Once peer support arrangements were placed following intervention and training, an immediate increase in the level of social interactions for all participants was noted. Only one participant was moved to a peer support arrangement at a time, guaranteeing the increase in interaction levels could be defined only by the implementation of the intervention. All other participants still in baseline remained at low levels of interaction, with similar elevation in interaction levels occurring upon the arrangmenet of the peer-mediated intervention. In addition to the visual analyses of these changes in rate of interaction and levels of academic engagement, a paired samples t-test was developed to compute the differences pre- and post- intervention across the four variables, interactions of students with disabilities, interactions of typically developing peers (both trained and untrained), interactions of all students (both with and without disabilities), and rates of academic engagement. For the interactions of students with disabilities, $t(2) = -4.152$, $p=0.053$, indicating marginally significant results. Although rates of interaction for students with high-functioning autism appeared dramatic across the graph and the overall average levels, the p-value indicates a level slightly above the typically accepted 0.05 level, possibly due to the low sample

size. Meanwhile, the interactional rates for peers, both trained and untrained, indicated statistically significant results, $t(2) = -4.570$, $p = 0.045$. These rates remained significant across all interactions, both for students with and without disabilities, $t(2) = -4.429$, $p = 0.047$. These values demonstrate that across a multitude of replications, there is little-to-no probability that the results of the present study occurred by chance, given that the output of pre- intervention values minus post- intervention values created a negative t score demonstrating statistical significance. One final variable; however, did not demonstrate the same level of significance, though this was expected of the research. For academic engagement, $t(2) = -3.246$, $p = 0.083$, as scores for academic engagement were already consistently high across participants prior to the initiation of their peer support plan.

Michael. Baseline levels of interaction indicate that initiations and responses among the focus student and peers occurred at 5.90% of intervals. More specifically, the focus student chose to interact with surrounding classmates for 5.21% of the class period, with peers responding only 3.09% to these attempts at communication. This indicates the necessity of social intervention, as the student sat in close proximity to peers but very rarely experienced reciprocal interactions with peers. A baseline rate of 5.90% indicates that on average, the focus student spoke to peers or was spoken to for approximately 3 minutes out of a 60-minute class period. Content of these incredibly limited interactions was typically appropriate, with some age-inappropriate outbursts or bouts of echolalic, scripted speech. Despite seemingly inappropriate speech, most affect was positive or neutral, with only one specific instance of negative initiation. His academic engagement averaged 57.92% of intervals, indicating typically an average normative rate with extensive periods of distraction.

Upon the introduction of a peer-mediated arrangement, immediate increases in social interactions occurred. Academic engagement dramatically increased to an average rate of 73.87% across the full class period, despite the continuation of whole-group instruction as the primary means of providing mathematics content. The student still indicated periods of distractibility and substantial off-task behaviors, but the peer supports provided structure and management to keep the student on-task across a greater percentage of intervals. In addition, Michael engaged in a higher percentage of social interactions during intervention, averaging 38.84% across intervals, with peer interactions also increasing to an average of 33.61% (26.24% for peer supports and 17.12% for other peers). The quality of these interactions remained high in both their content and their affect, with Michael engaging in typically age-appropriate conversations, often linked in academic content.

Angela. During the baseline period, Angela's social interactions averaged at about 3.52%, with some variability based on instructional formatting ($SD = 12.23$). One significant spike in social interactions was noted for a lab day, in which students were assigned to small groups and partners and required to interact as they navigated a complex academic topic. Despite this peak, the introduction of peer support arrangements created an immediate change in the overall level of interactions. Social interactions increased to an average of 32.24% of intervals, with Angela interacting 21.41% of the class period. Peer-directed interactions toward Angela also showed a remarkable increase, up to 31.09% intervals on average (31.88% for peer supports and 0.92% for other peers), as compared to an average of only 3.38% during the baseline. The content of interactions continued to indicate age-appropriate conversational topics, and average ratings of affect remained consistent, remaining at a positive mark across baseline and intervention.

Angela's academic engagement also stayed consistently high ($M = 98.43$ at baseline, $M = 99.25$ during intervention). Significant variation in instructional formats was noted across baseline and intervention in the classroom, though a tendency toward whole-group instruction remained. Despite this, peer partners found many strategies to intermittently provide support and engage the focus student in conversation before and after class.

Tanner. Levels of social interactions remained below 9.71% during the baseline period, with Tanner interacting 5.67% of intervals and peers initiating and responding across 9.24% of intervals. Content of these interactions was typically age-appropriate, and the affect was consistently positive. Only a few select peers chose to interact with the focus student across this period, keeping all data relatively low. These low rates of interaction may be partially explained by the heavy involvement of the paraprofessional in interactions, as the paraprofessional was in proximity to the students and limiting conversation across 89.23% of intervals.

Introduction of the peer supports resulted in an immediate increase in the level of social interactions. Improvement in the average level of social interactions ($M = 18.10$) was accompanied by greater rates of variability ($SD = 8.84$), though it was still consistently higher than the baseline. Peer interactions also increased on average to 17.00% (with 18.94% for peer supports). These interactions were typically age-appropriate and affect was consistently positive across interactions. Paraprofessional involvement in these conversations also dropped significantly, with proximity reaching an average of only 1.98% across observations. Despite the increased socialization and removal of continuous adult prompting, Tanner's academic engagement remained high throughout the peer support intervention phase ($M = 94.3$ at baseline, $M = 97.91$ in intervention), exceeding the normative level for the class.

Adult facilitation and Peer Academic Support

Adult facilitation. Adult facilitation during baseline varied between each of the focus students. For Michael, adult facilitation and proximity occurred at an average of 17.01% of intervals, though there was substantial variability ($SD = 18.78$). He remained in proximity to peers from baseline ($M = 76.40$) through intervention ($M = 97.02$ for peer support, $M = 89.67$ for other untrained peers). Angela demonstrated typically low rates of adult involvement and proximity ($M = 18.80$ at baseline, $M = 18.78$ at intervention), except on days when content required additional requests for assistance, leading to greater rates of variability ($SD = 28.63$ at baseline, $SD = 35.23$ at intervention). Tanner, meanwhile, demonstrated very high rates of adult involvement in his academics and socialization, with the paraprofessional remaining in proximity for 89.23% of intervals, with little variability ($SD = 5.15$). Upon the development of the peer-mediated intervention; however, paraprofessional proximity and involvement decreased for Tanner ($M = 1.98$), with the paraprofessional simply checking in with trained peers rather than sitting directly next to the student with HFA.

Peer academic support. Peer academic and social support demonstrated a steady, increased rate during intervention. Michael experienced an increase in peer academic support from 0.42% during baseline to an average of 23.05% during the peer support arrangement. For Angela, peer academic support increased from 4.31% during baseline to an average of 33.47% during the intervention phase. Finally, Tanner's peer academic support increased from 9.26% during baseline to an average of 21.67% with peer support systems in place.

Discussion

The present study strove to determine the effectiveness of peer-mediated interventions for middle school students with autism on student social and academic outcomes. Researchers investigated whether the incorporation of a peer network in the classroom setting could improve not only the academic engagement and shared supportive roles but increase the focus students' engagement in social conversations and friendships. Through a single-case design study of three individuals with high-functioning autism, researchers successfully determined the critical role that peers can play in both social and academic outcomes. For all three students, rates of academic engagement remained high, peer academic support increased, and overall social interactions, both academic and conversational, increased.

In this study, peer support arrangements were found to be an effective method for improving socialization of students with high-functioning autism in the classroom, while still retaining the integrity of classroom learning. Peers learned to work with one another, at times even enhancing their academic knowledge and understanding of content, while also gaining new social connections and hopefully lasting friendships. For students whose core deficit is social and communicative functioning, an intervention such as this creates a pivotal opportunity. Students are given specific strategies to enhance their interactions and opportunities to work empathetically and cooperatively with one another, increasing the validity of the inclusion movement seen across American schools. Beyond increasing peer interactions and maintaining strong levels of academic engagement, these interventions may also present an opportunity for specific and explicit social skills instruction. Students both with high-functioning autism and without, who served as peer supports in this arrangement, are taught specific methods for modeling and providing appropriate feedback and conversational structures. They are given

specific methods for engaging one another in conversation, and for broadening the connections

to peers outside the study. This will become a critical facet in the movement for inclusive

education and inclusive language, as students become capable of maintaining positive and

inclusive environments beyond the direct and continual reminders of an adult. The intervention

also encourages social connections for students involved across the span of a semester, hopefully

setting a platform on which true, authentic friendships can be built beyond the 60-minute class

period. Despite these dramatic increases in socializing during class instruction, it appears that the

social benefits are achieved without a negative impact to academic engagement with the general

education curriculum. Students involved in the study maintained rates of academic engagement

that were typical or above the normative average for the remainder of the class, and many of

their conversations during the instructional period were related to content. However, these

conversations then opened an opportunity to continue conversation beyond academics once the

instructional period ended, during the ever-critical transition time between classes. It is the hope

that through these interventions, students may begin to carry their conversations out of one

classroom door and into the next, as these moments between classes serve as a vital opportunity

for the middle school social realm. Although such follow-up was not executed in the present

study, it serves as an excellent point for developing future research to better understand

generalizability and authentic friendships.

Recommendations for Practice

Findings from this study mirror those of previous research and serve to extrapolate

critical insight to a new population of high-need (Bambara et al., 2016; Carter et al., 2014).

There are many critical implications for educators, both teachers of general education and special

education, and for others responsible in the support of students with autism in the general

education classroom. Students with autism require purposeful planning, strategies, and support to

thrive in the general education classroom. Although many of these students may succeed

academically on their own or with minimal adult prompting and support, they seldom interact

and participate with their typically developing classmates (Bambara et al., 2016; McDonnell et

al., 2001). These students are often found in the front or back row of the classroom, isolated from

their peers, with the close monitoring of a paraprofessional. A model such as this fails to

appreciate the definition of inclusion as has been mandated by previous legislation and a variety

of disability advocacy groups. The primary purpose of inclusivity in the general education

classroom is to allow for student development in their least restrictive environment, by providing

access to both the content and typically developing peer models. It is therefore the responsibility

of the educators to maintain a comfortable learning environment in which students with HFA are

included not only in the learning of content, but in the learning and integration of key social and

emotional skills for lifelong success in the social setting.

It is evident from the baseline data that sitting in proximity to the peers is not enough.

Students must have explicit methods for communicating with their peers and may benefit from

specifically identified peers they can turn to in times of questions or simple desire for

conversation. Peer-mediated interventions and peer-support arrangements present an exceptional

guide for engaging peers in supporting the participation of the student with HFA. In addition,

these interventions help peers and students with HFA recognize opportunities for social

interactions and more appropriate ways for initiating these, as well as encouraging the

development of social connections and hopefully friendships. All of these key benefits can be

reaped with minimal intervention, resources, or educator commitment or time. Training,

facilitation, and documentation are incredibly minimal, making it a feasible and simplistic option

for the school staff to implement. The entire training period for special educators and

paraprofessionals can be completed in less than two hours, and peers are trained in a half-hour

session and then provided continual feedback and support in the authentic classroom setting

while working with the student with HFA.

Limitations and Directions for Future Research

Several limitations to the present study present important research questions for the

continuation of review in this domain of intervention. First, this study used a randomized

procedure to determine a singular specific class period in which to implement the intervention

for each participant. It may be interesting in the future to expand these interventions across class

periods, as students tend to spend much of their day with a similar group of peers. By bridging

the divide across the school-day, students will be given multiple opportunities for interaction and

a broader variety of conversational topics when beginning the intervention, increasing the

likelihood of authentic friendship development and thereby strengthening social connections and

relationships.

It may also be interesting to conduct this intervention in relation to another form of

evidence-based practice such as social skills training. Given the high functioning nature of the

students involved in this study, little time was devoted to explicit instruction in social and

conversational practices. It was almost assumed that given their involvement in the inclusive

placement, these students would be able to pick up necessary social cues to fend for themselves

in the classroom. However, as noted at baseline, these students are missing an exceptional

amount of opportunities for social engagement. Therefore, utilizing a combination approach for

strategies could encourage and even impact the increases in positive social interactions and

connections.

Another difficulty in the completion of this study was the recurrent absences of various students and adults involved in the program. As a component of human research, there is exceptional variability in students' attendance in the classroom, given their involvement in various extracurriculars (at this middle school, many students were involved in a drama production) and potential illnesses. Teachers, too, are susceptible to such activities and ailments, and inconsistency can present greater difficulties in results. It may be interesting to provide more continuous streams of support by training all educators involved in the classroom, and by increasing the involvement of the general educator in the development of the peer support plan. In addition, attempting to involve different numbers of students in the peer arrangement could impact the outcome. In the present study, two peers were utilized per student to support their academics and social engagement. Although this number was not a concrete value determined prior to recruitment, in each case, two peers expressed interest in involvement and returned consent forms for participation. Using more or fewer peers could have a different effect on the outcomes of the study. In addition, rearranging the classroom layout could impact the social interactions. For example, in the science classroom setting in which two students received intervention, students were placed in table rows of two-students-per table. This severely limits the opportunities for conversation and negotiation of meaning as students must lean across aisles or turn completely around in their seats to engage with a novel peer. Attempting different methods of seating, such as turning tables into small pods or small groups, could encourage an increase in socialization and peer academic support throughout the class period.

Beyond these logistical challenges and inquiries lies questioning in the methodology for statistical analysis, as the single-case design format shows substantial deviation from the typical large-n psychological study, while still presenting a valid, reliable, and widely accepted research

practice in special education (Hayes, 1992; Hitchcock & Chezan, 2015; Wolery, 2012). For this study, the use of both visual analyses, averages and variance, and inferential statistics were incorporated to attend to the strengths of both psychological and education-based research. Typically in single-case design, only visual analysis and quantitative date is used to determine the effectiveness of practice, as trends and rates of social interaction and academic engagement are typically very visible upon simple observation. These observations and graphs are then supported by substantial changes in average interactions, and variance in these interactions. However, this method of statistics does not provide substantial inferential data for understanding the replication and broader application of such research. Although atypical of an educational study of students with disabilities, researchers in the present study strove to find this potential for inference by utilizing a paired samples t-test to determine the p-values and levels for statistical significance. By extrapolating this additional information from the data, it was determined that the results of such a study were not simply due to random chance, but rather the pure effectiveness of intervention. However, the broad application of this statement should still be taken with a certain amount of caution, as the use of a t-test in single-case design is not typical protocol, and inferential statistics are subject to considerable bias given the small sampling pool from which all data were taken. Therefore, more research must also be done in the use of inferential statistics in parallel with visual analyses as a potential practice for determining wider application of intervention, as this method is not widely practiced in special education research. A meta-analysis of several studies utilizing these various statistical protocols could yield critical insight into the validity and importance of usage of various measures of statistical analysis in determining intervention effectiveness.

Conclusion

Peer-mediated interventions are an efficacious practice in promoting positive social and academic outcomes for students with high-functioning autism in the general education setting. The current study adds and extends previous literature through its implementation of this evidence-based practice with a new population, students with no cognitive impairment or more severe disability label. Although the program shows promise as a means of increasing social interactions and academic support while maintaining high academic engagement, more research is needed to determine the effectiveness and strength with which these interventions work in the complex classroom environment.

Appendix

Figure 1. Indicates the social interactions, separated as initiations and responses, of students with

HFA at baseline and throughout intervention across a multi-tiered system.
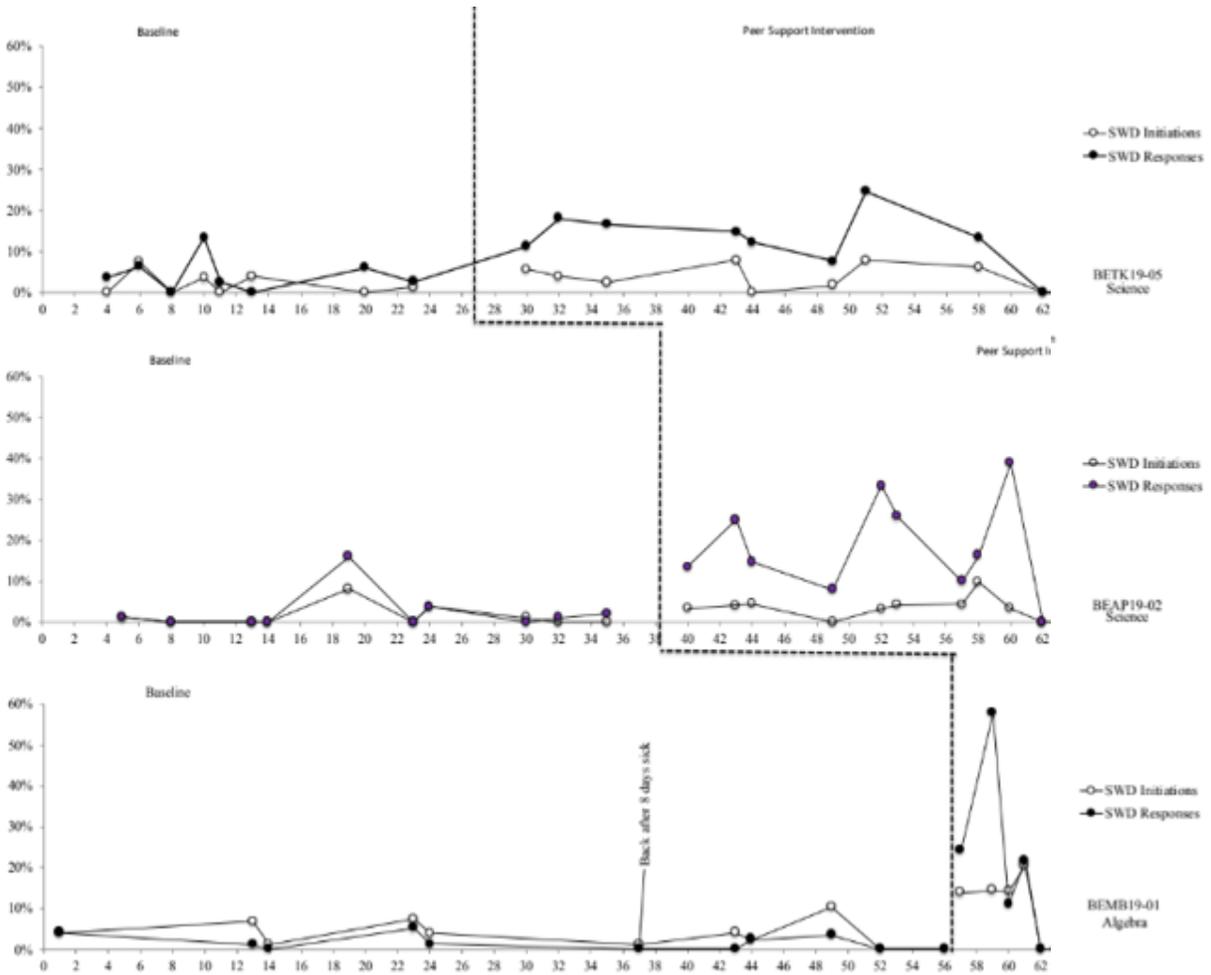
Figure 2. Indicates the combined scores for initiations and responses of students with HFA at baseline and throughout intervention across a multi-tiered system.
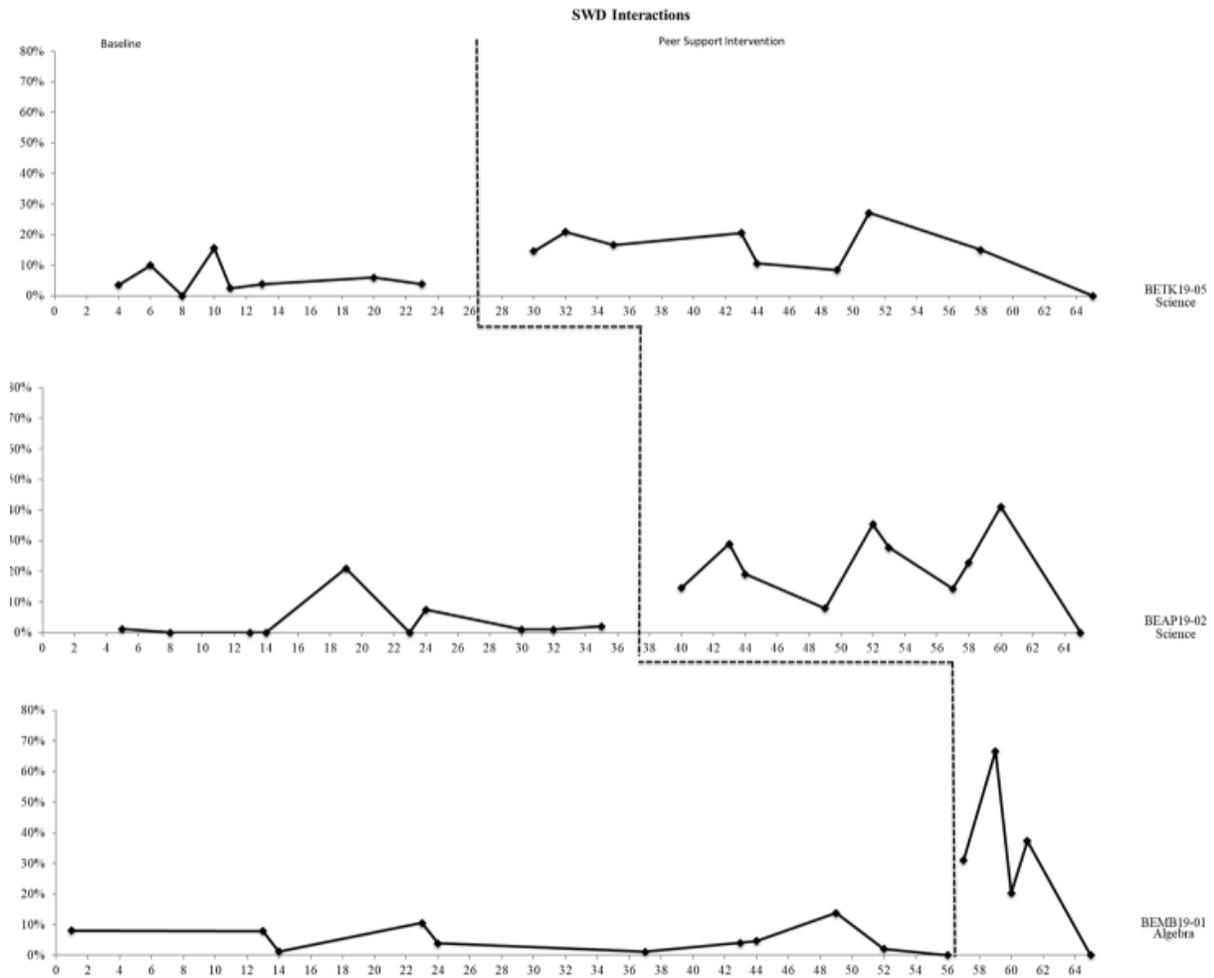
Figure 3. Indicates the average levels of academic engagement of students with HFA at baseline

and throughout intervention across a multi-tiered system.
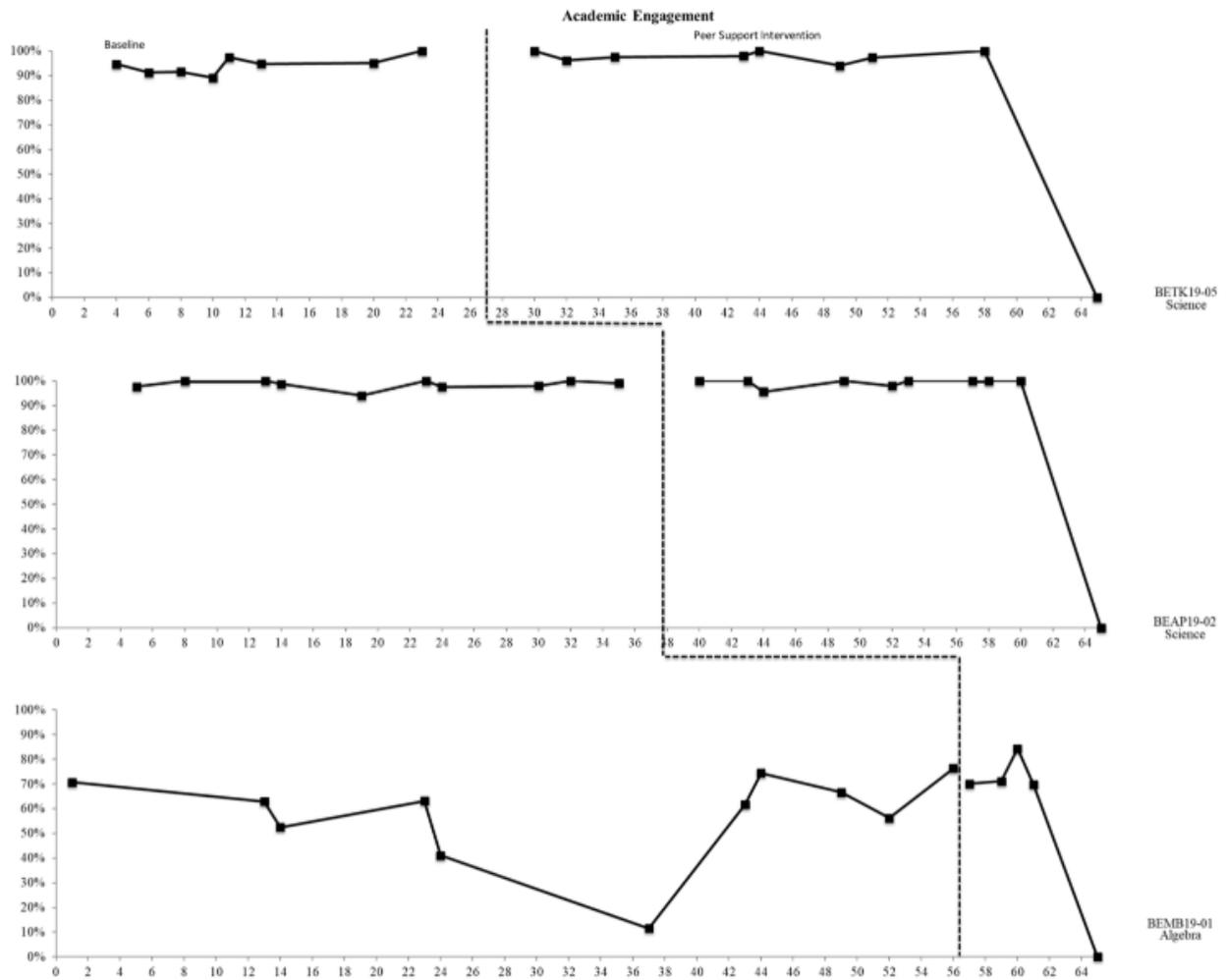
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