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Journal of the Division on Autism and Developmental Disabilities

The purposes of this organization shall be to advance the education and welfare of persons with autism and developmental disabilities, research in the education of persons with autism and developmental disabilities, competency of educators in this field, public understanding of autism and developmental disabilities, and legislation needed to help accomplish these goals. The Division shall encourage and promote professional growth, research, and the dissemination and utilization of research findings.

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Preventing Bullying and Promoting Friendship for Students with ASD: Looking Back to Move Forward

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Abstract: Now more than ever, students with autism spectrum disorder (ASD) are being taught in inclusive settings. Despite inclusion initiatives, research suggests students with ASD have limited social interactions with neurotypical peers and have significantly fewer high quality friendships compared to neurotypical peers. The purpose of this paper is two-fold. First, we discuss how friendship development has been supported and targeted in school settings. Then, we discuss directions for future research and highlight the urgency of research in this area given the numerous negative outcomes associated with limited friendships and high rates of bullying victimization.

Since the initial establishment of the Education for All Handicapped Children Act of 1975, federal legislation and school reforms have focused on ways to provide equal educational opportunities for students with disabilities and provide access to the general education curriculum. Now more than ever, students with autism spectrum disorder (ASD) are being taught in general education classrooms. In 2013, approximately 60% of students with ASD were taught for 40% or more of their school day in general education classrooms (NCES, 2016).

In inclusive environments more opportunities occur for students with and without disabilities to interact (Mavropoulou & Sideridis, 2014). However, despite increased access to more inclusive environments and opportunities to engage with peers, students with ASD often experience difficulties accessing afforded rights within these inclusive environments. Indeed, two critical problems in the school context can severely impact the full participation of students with ASD: limited, or lack of, friendships with peers (Petrina, Carter, & Stephenson, 2014) and frequent bullying victimization (Sreckovic, Brunsting, & Able, 2014).

Despite inclusion initiatives, research suggests students with ASD engage in limited social interactions with peers and have significantly fewer reciprocal and high quality friendships compared to their typically developing peers (Humphrey & Symes, 2011; Locke, Ishijima, Kasari, & London, 2010). When compared to their typically developing peers, students with ASD spend less time in cooperative activities and more time in solitary activities at school (Bauminger, Shulman, & Agam, 2003; Humphrey & Symes, 2011; Wainscot, Naylor, Sutcliffe, Tantam, & Williams, 2008). Further, research consistently documents that youth and adolescents with ASD have poorer quality friendships, fewer reciprocal friendships, less contact with peers outside of school, and the duration of friendships are shorter compared to their peers without ASD (see Petrina et al., 2014, for a review). Research suggests that youth with ASD educated in inclusive classrooms are only involved in their peers’ social relationships approximately 50% of the time (Rotheram-Fuller, Kasari, Chamberlain, & Locke, 2010). As students enter middle and high school they become even less connected. In a nationally representative longitudinal...
study of the involvement of adolescent students with disabilities, students with ASD were reported as the least likely to frequently see friends outside of school, receive telephone calls from friends, and get invited to another student’s social event (Wagner, Cadwallader, Garza, & Cameto, 2004). Both educators and families have expressed concern about the lack of opportunities school-age children with ASD have for building friendships with their peers in schools (Bauminger et al., 2003; Boyd & Shaw, 2010; Kasari, Locke, Gulsrud, & Rotheram-Fuller, 2011). And individuals with ASD have indicated they want to develop social relationships (Daniel & Billingsley, 2010; Müller, Schuler, & Yates, 2008).

It may not be surprising youth with ASD struggle to develop relationships with peers because by definition individuals with ASD have challenges in social communication and interaction (APA, 2013). Students with ASD often have difficulty initiating and responding to peers. For example, students with ASD may have difficulty introducing topics of interest and relevance, using age appropriate greetings, and understanding facial expressions, humor, and other people’s feelings (Paul, Orlovski, Marcinko, & Volkmar, 2009; Weiss & Harris, 2001). Some students with ASD who have narrow interests may monopolize a conversation and not allow others to contribute their thoughts and/or interests resulting in an unbalanced conversation. Researchers have also noted an initial increase in aggression, self-injurious behavior, anxiety, and depression during adolescence (Hammond & Hoffman, 2014; Schall & McDonough, 2010), which may further make engaging in positive social interactions difficult. These deficits in social interaction and communication can directly impact friendship development and bullying victimization. In fact, research suggests friendships can serve as a protective factor against bullying victimization (Boulton, Trueman, Chau, Whitehead, & Amatya, 1999; Hodges, Boivin, Vitaro, & Bukowski, 1999), therefore social interaction and communication deficits coupled with few friendships increases the risk students with ASD are bullied by peers (Sreckovic et al., 2014).

In fact, students with ASD have been reported to experience bullying victimization more than the general population (e.g., Little, 2002) and more than their peers with other disabilities (e.g., Humphrey & Symes, 2010; Rowley et al. 2012; Twyman et al., 2010). While prevalence of bullying victimization rates among youth with ASD range across studies, a review indicated prevalence estimates reported within the past year to be between 46% and 94% across studies (Sreckovic et al., 2014). In contrast, bullying victimization rates among the general adolescent population in the United States in 2011 were estimated to be 28% (Robers, Kemp, & Truman 2013). Research suggests students with ASD are more commonly victims than bullies or bully-victims (Zablotsky, Bradshaw, Anderson, & Law, 2013). This may not be surprising given that the profiles of students with ASD are often very similar to the profiles of both provocative and passive victims (e.g., have limited friendships, show signs of low self-esteem; Olweus, 1993; Orpinas & Horne, 2006; Sofronoff, Dark, & Stone, 2011). Many of the common characteristics associated with victims of bullying are also characteristics commonly used to describe students with ASD (Sreckovic et al., 2014). The greatest risk factors for bullying include young age, communication difficulty, internalizing mental health concerns, having parents with mental health concerns, and having few friends (Cappadocia, Weiss, & Pepler, 2012).

The limited positive social interactions and friendships students with ASD have with their peers are concerning considering interactions and relationships with peers can make important contributions not only to their overall quality of life, but to their success in school, as well (Rubin, Bukowski, & Laursen, 2009). During school, rejected students are less likely to participate in classroom activities and more likely to perform poorly on achievement assessments (Buhs & Ladd, 2001). Peer rejection can also lead to an array of psychological problems including loneliness (Parker & Asher, 1993) and internalizing and externalizing behavioral problems (Ladd, 2006). Further, adolescents with poor social adjustment are at risk for school drop-out and delinquency (Parker & Asher, 1987). For individuals with ASD, social-related problems can persist into adulthood and make navigating work and community relationships challenging (Sperry & Mesibov, 2005). On the contrary,
research suggests adults with ASD who have greater quantity and quality of friendships report lower levels of loneliness (Mazurek, 2014).

When these individuals are subjected to bullying victimization, the negative consequences become even greater. Bullying victimization can lead to numerous negative consequences, including but not limited to, developing internalizing and externalizing behavior problems, dropping out of school, and suicide (Olweus, 1993; Parker & Asher, 1987). Victimization has been linked to an array of internalizing behavioral problems, including loneliness, anxiety, depression, negative self-concept, and low self-esteem (Hawker & Boulton, 2000). Students with ASD who have experienced victimization have been reported to experience physical injuries and emotional trauma and feeling scared for their safety (Zablotsky et al., 2013). The National Autistic Society reported students with ASD who were victimized suffered from damaged self-esteem, poorer school work quality, and negative impacts on mental health, social skills, and relationships (Reid & Batten, 2006). More than 30% of students with ASD missed school and almost 20% changed schools due to bullying (Reid & Batten, 2006). Moreover, peer victimization has been identified as a risk factor of suicidality in individuals with ASD (Segers & Rawana, 2014).

Intervening to protect students with ASD from experiencing these negative consequences is imperative. The purpose of this paper is two-fold. First, we discuss how friendship development has been supported and targeted in school settings. Then, we discuss directions for future research and highlight the urgency of research in this area given the numerous negative outcomes associated with few friendships and high rates of bullying victimization.

**Supporting Friendship Development**

Authentic friendships play a crucial role for children with disabilities to achieve successful outcomes across their lifespan (Schuh, Sundar, & Hagner, 2015). With a higher prevalence of students with ASD in the classroom, concerns for opportunities to create social networks, specifically individual friendships is increasing as well (Rotheram-Fuller et al., 2010). Statistically, this is reported as equivalent among neurotypical peers, as only half report having friends with disabilities (Dyson, 2005). This could be due in part to the fact that both students with and without ASD need help to develop social communication skills that are needed for friendships (Diamond & Tu, 2009; Jones & Howley, 2010).

Many traditional definitions of “friendship” include the construct of reciprocity. While these relationships should be meaningful to both parties, friendships may have a different meaning for children with ASD. There is evidence that children with ASD may have difficulty distinguishing the role of friendship in a way similar to the manner in which a neurotypical child would identify friendship (Bauminger & Kasari, 2000). Specifically, children with ASD are less able to identify qualities of friendships and struggle to understand the social-emotional components of loneliness (Bauminger & Kasari, 2000). Moreover, individuals with ASD understand loneliness differently and experience loneliness more intensely and more frequently than neurotypical children. Additionally, it has been discovered that even when friendships are present, the quality of friendships are suffering (Bollmer, Milich, Harris, & Maras, 2005; Locke et al., 2010). Specifically, the level of companionship and helpfulness is of less benefit, and the friendships are shorter and less stable than friendship between neurotypical peers (Bauminger et al., 2003; Rowley et al., 2012). Also, contributing to lower quality of friendships is the short length of friendship.

**Inclusion**

A review of 20 studies in seven countries examining students’ attitudes towards peers with disabilities found that students generally hold neutral attitudes toward peers with disabilities (de Boer, Pijl, & Minnaert, 2012). Younger children often have positive attitudes toward persons with disabilities (Hong, Kwon, & Jeon, 2014). The study investigated children’s willingness to include peers with disabilities in social settings. It was concluded that kindergarteners’ understanding of disabilities and experiences interacting with individuals with exceptionalities had an impact on their will-
ingness to include a peer in specific social situations (Hong et al., 2014). Connections between attitudes and social interactions which may promote friendships has been examined for some time (e.g., Diamond & Hestenes, 1994). Researchers analyzed several studies examining young children’s attitudes in relation to intended behaviors (Yu, Ostrosky, & Fowler, 2012) which suggests observations and interactions with the peers in an inclusive setting can impact the ability to recognize and understand their peers with disabilities better.

Even if neurotypical peers possess positive views of peers with disability, it does not always translate into developing authentic friendships (Dyson, 2005). Characteristics of children with disabilities can contribute to neurotypical peers’ willingness to include classmates in social contexts. Children with disabilities are alienated from their social peer group when aggressive behavior, limited social communication and motor skills are prevalent (Odom, 2005). Although, inclusive classrooms have been found to be the place of origin for friendships between children with and without disabilities (Bauminger et al., 2003), proximity itself is not an effective catalyst for authentic connection. In inclusive classrooms, children with ASD are only involved in peers’ social relationships about half of the time and appear to interact even less as the grade level increases (Rotheram-Fuller et al., 2010). Therefore, the mere presence of children with disabilities in the same learning environments as neurotypical peers is unlikely to organically create connections between students of diverse abilities (e.g., Diamond & Tu, 2009).

Friendship Interventions

Most interventions aiming to promote friendship, teach specific social skills to the individual with ASD. Examples of outcome measures include social interactions, conversation skills, and perspective taking (Reichow & Volkmar, 2009). Typically, interventions focus on improving social and emotional skills only for the students with ASD (Bellini, Peters, Benner, & Hopf, 2007), and fall into one of two general categories: Social Skills Training (SST) or Peer-Mediated Instruction/Intervention (PMII).

Social Skills Training. Social skills training (SST) can include group or individual teaching of specific social skills and is considered an evidence based practice for individuals with ASD (Wong et al., 2014). Individual interventions are carried out with a professional and an individual with ASD addressing the individual’s specific skill needs (Griffin, Sam, & AFFIRM Team, 2016). Each program is individualized and typically evaluated with single-case design methods. While this type of intervention can yield improvements in social skills, it can be resource intensive and difficult to generalize skills to social settings.

Social skill group interventions can address the need for using resources more efficiently than individual interventions. Further, group interventions allow for opportunities for practicing social skills. In their meta-analysis of social skill group interventions, Gates, Kang, & Lerner (2017) reported a significant variability in the characteristics of social skill groups. Participants can range in age, though most groups focus on a small range within a group. Group interventions vary in how they are structured; some focus on social skills instruction, while others provide a context for social interactions to take place. Groups also vary in their length (a few weeks to 2 years) and intensity (1 hour sessions to 6 hour sessions; Gates et al., 2017). Group social skill interventions are associated with moderate improvements in social competence. However, most programs do not specifically measure friendship as an outcome.

Peer-mediated Instruction/Interventions (PMII). Peer-mediated instruction/interventions (PMII) are a group of interventions in which peers are the intervention agents engaging students with disabilities to help them learn new skills (Chan et al., 2009; Sperry et al., 2010; Strain & Odom, 1986). PMII is rooted in both behaviorism and social learning theory (Sperry et al., 2010) and is considered an evidence-based practice, according the National Professional Development Center on Autism (Wong et al., 2014). It has been shown to be effective in promoting social and academic skills for students with a variety of disabilities (Bass & Mulick, 2007; Carter, Sisco, Chung, & Stanton-Chapman, 2010) and has been especially effective for students with ASD (Zhang & Wheeler, 2011). In a systematic review of
PMII, Chan and colleagues (2009) found that 91% of the studies they evaluated yielded positive outcomes for students with ASD. Further, while friendship development has not been a common dependent variable in PMII studies, some studies have explored the impact of PMII on friendship and found friendships between students with ASD and their peers have formed (e.g., Gardner et al., 2014; Sreckovic, Hume, & Able, 2017).

Anti-bullying Interventions

Anti-bullying interventions vary in the types of strategies and supports used to reduce bullying (Merrell, Gueldner, Ross, & Isava, 2008). Programs may include staff training, student training, environmental changes, and/or policy changes. In their meta-analysis of anti-bullying programs, Merrell and colleagues (2008) concluded that most anti-bully programs were associated with some positive outcomes, but the effect sizes were weak. Additionally, they found that a small number of anti-bullying programs had negative effects, meaning that bullying increased after the intervention. Most of the intervention studies have not been replicated to determine the efficacy of specific programs. Further, most programs rely on student and teacher report of anti-bullying knowledge as opposed to observation of bullying behavior (Merrell et al., 2008). In another review, Ttofi and Farrington (2011) found that the most effective programs were intensive, long in duration, included parent meetings, included high levels of supervision during recess, and upheld firm disciplinary consequences for bullying. Both articles concluded that more research is needed to identify evidence-based anti-bully programs. Of the reviewed studies only one program measured positive peer interactions and one measured peer acceptance (Merrell et al., 2008).

Within the area of anti-bullying programs, most are not specific to supporting students with disabilities who are victims of bullying. In a recent systematic review, only six studies were identified that focused on bullying and students with disabilities (Houchins, Oakes, & Johnson, 2016). Of these six studies only one met all eight Council for Exceptional Children (2014) quality indicators and two studies met seven of the eight quality indicators.

None of these interventions were specific to students with ASD nor did they measure friendship development.

Future Directions for Research and Practice

Most research and interventions aimed at improving social situations for individuals with ASD focus on improving social skills of students with ASD or on preventing bullying. The most recent efforts to combat bullying focus on training educators on defining, recognizing, preventing the occurrence of bullying, while social skills interventions focus primarily on skill development of students with ASD (Bellini et al., 2007; Schneider, Goldstein, & Parker, 2008). While both of these types of interventions address important areas, they do not specifically promote friendship development. Given the numerous negative consequences associated with limited, or lack of, friendships and bullying victimization, it is imperative that research expands in these critical domains specifically for students with ASD. While many school districts are trying to put practices in place, particularly to reduce bullying, they often address the general population and do not meet the multifaceted needs of students with ASD. School administrators need guidance from research on efficacious practices to help individuals with ASD foster and maintain friendships and reduce rates of bullying. In the following section we highlight several important areas of future research. Specifically, we emphasize the need for urgency in reducing victimization and highlight the gap between the promoting and maintaining authentic friendships within our current evidence-based social interventions, and the inherent need to gather the voices and perspectives of student with ASD relating to developing meaningful friendships.

Context and Role of Schools in Supporting Students

Future research needs to evaluate the direct impact of anti-bully programs on students with ASD. Current anti-bully programs are evaluated on a variety of variables, but typically do not specifically assess outcomes for students with disabilities. Future research should measure if and how well anti-bully programs re-
duce bullying for students with ASD. Because research indicates that most anti-bullying programs are only moderately successful (Merrell et al., 2008), future interventions could add elements specific to reducing bullying for students with ASD. For example, one element that may possibly improve anti-bullying programs could be to use befriending interventions. As discussed earlier in this paper, students with ASD often struggle with social skills (APA, 2013) and could benefit from skills specifically targeting friendship development. Anti-bully programs should be coupled with peer sensitivity training or other programs that promote friendship.

Knowledge children have about ASD and attitudes they hold towards persons with ASD impact their willingness to interact with peers with ASD (Bagwell & Schmidt, 2011; de Boer et al., 2014). For friendships to flourish, the focus of trainings should not only be on students with ASD. Neurotypical peers need to better understand and accept their peers with ASD (Meyer & Ostrosky, 2014) and more trainings targeted for neurotypical children are needed. Because of the limited literature about school-based peer sensitivity trainings, it is important to examine how students can benefit from ASD awareness training and understand how the training students receive change their attitudes and beliefs about their peers with ASD (Rossetti, 2011). There is evidence demonstrating that when students receive information through multi-modal presentations (e.g. workshops, videos) their attitudes towards peers with ASD improve (Rossetti, 2011). In particular, when students receive training about characteristics of ASD and learn about strategies for interacting with peers with ASD while pointing out their strengths, students will develop better knowledge about children with ASD and increase their intentions for interacting with their peers (Silton, 2009). Kasari and colleagues (2011) found that six weeks of peer training showed significant improvements in the number of peers with ASD students nominated, the social skills classroom teachers reported in students, and a decline of incidents of isolated play on the playground for children with ASD.

A critical first step is removing barriers to understanding that similarities should be prioritized over differences, as well as minimizing perceptions of lower status or ability level, is essential to creating authentic connections leading to friendship (Finke, 2016). The impact of anti-bullying programs and peer sensitivity training together need to be evaluated to assess the impact on friendship.

Further, once effective interventions are implemented and friendships are formed between students with ASD and their peers it is imperative to examine the longevity of those friendships. In other words, does the friendship continue after the intervention is implemented and what does the friendship look like? Research is also needed to examine the direct effects of the friendships on the psychological well-being of individuals with ASD, as research has identified the negative consequences of not having positive peer relationships, including loneliness (Parker & Asher, 1993) and internalizing and externalizing behavior problems (Ladd, 2006). As stated above the friendship may look different than a “typical” friendship, but the student with ASD may still benefit from the positive consequences of having a friend regardless if the friendship fits the “typical model” of a friendship.

**Perspectives of Students with ASD**

Future inquiry is also needed to better understand the effects of diagnosis disclosure on peer relationships, acceptance, and bullying. The Reciprocal Effects Peer Interaction Model developed by Humphrey and Symes (2011) asserts that lack of awareness and understanding of ASD can result in limited peer friendships and social networks and increased bullying victimization. Yet, few studies have examined the impact of increased awareness and understanding of ASD in the form of diagnosis disclosure, Campbell (2007) investigated the effects of educational messages delivered to middle school students regarding a video of an unfamiliar student displaying ASD-like behaviors. Results indicated students who were unfamiliar with ASD reported more favorable attitudes when they were provided with both explanatory and descriptive information. Students with prior knowledge of ASD reported more positive attitudes regardless of the message. Research also suggests the person delivering information about ASD (e.g., doctor, mother) may impact student atti-
tudes (Morton & Campbell, 2008). This topic may be difficult to investigate because empirical information on diagnosis disclosure is sparse. Therefore, we encourage research teams to interview individuals with ASD who have already disclosed their diagnosis to their peer group, as well as interview their families and teachers, to gain a better understanding of their experience, including how they disclosed their diagnosis and what happened immediately after and over time.

Individuals with ASD have been found to comprehend some aspects of friendship, but are less equipped than neurotypically developing peers (Bauminger & Kasari, 2000) to advocate for how friendship may look like in real-life situations (Finke, 2016). This may be due in part to the lack of opportunity to interact and build ongoing relationships with peers (Daniel & Billingsley, 2010; Finke 2016). The lack of experience limits the ability to truly understand how connections are initiated and the roles individuals play in creating and maintaining friendships.

An important point to make is that traditional definitions of friendship include the terms “reciprocity” and “mutual” (Bagwell & Schmidt, 2011; Bauminger-Zviely, 2013). For individuals with ASD, the focus should be less on these terms and more on “transactional”. Friendship can look or play out in many ways, as longs as both parties find benefit from the interaction then it is worthy to be viewed as an authentic connection. The characteristics and ‘deliverables’ do not need to be of equal identity or value. As a field, we need to gather information from students with ASD about what is most meaningful in a friendship. What does a high-quality friendship mean? Which activities do they wish to engage in? What will promote an interaction? Sustain an interaction? Once we know the motivation for individuals to engage in friendship-building activities we can create a positive environment in which to elicit such interactions among students with diverse needs.

Conclusion

Individuals with ASD often experience bullying victimization and have few, if any, friendships. These two critical problems can result in a multitude of internalizing and externalizing behavioral problems. It is imperative that research expand on efforts to help individuals with ASD foster and maintain friendships and reduce rates of bullying victimization. All children deserve to benefit from a high quality education, including positive academic, social, and behavioral gains, and students with ASD are no exception.

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Exploring Post-School Outcomes across Time Out of School for Students with Autism Spectrum Disorder

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Abstract: While one generally assumes the longer one is out of school the more positive his or her outcomes this may be, this may not be accurate. Little research systematically explores the relationship between time after exiting high school and post-school outcomes, especially for students with disabilities. This study represented a secondary analysis of the NLTS2 aimed at understanding the immediate and long-term post-school outcomes of students with autism spectrum disorder (ASD) and the relationship among those outcomes. The main findings suggest positive results for some post-school outcomes examined when considering improved success the longer one was out of school (e.g., attending and graduating from post-secondary education and employment). However, inconsistent, at best, and negative, at worst, results were found for working full time and wage earning the longer one with ASD is out of high school.

Exiting high school is an exciting – and critical – time for secondary students, often associated with increased freedom, responsibilities, and opportunities (Heckhausen, Chang, Greenberger, & Chen, 2013). In theory, students engage in choices regarding their future, including attending post-secondary education or obtaining employment; students may also select their living arrangements, such as living independently from their parents (Guo, Marsh, Morin, Parker, & Kaur, 2015). Data from the National Center for Education Statistics and the Institute of Education Sciences (IES) suggest 25.2 million students are enrolled as undergraduates in the United States, with 42.2% of those attending public two-year institutions and 31.4% attending public four-year institutions (Ginder & Kelly-Reid, 2013). Typically, if one does not attend a post-secondary institution, one enters the job market. Recent data from the United States Department of Labor indicated 38.8% of 18–19 year olds and 62.9% of 20–24 year olds were employed in labor market (Bureau Labor Statistics, 2014).

Beyond the post-school experiences for students in general, particular attention is paid to the post-school outcomes of students with disabilities. Historically, students with disabilities struggle during their years after high school (i.e., adult years), including experiencing lower rates of attendance at post-secondary institutions, lower rates of employment, and lower rates of independent living (Blackorby & Wagner, 1996). More recent data suggest attention is still needed to the post-school experiences of students with disabilities. Newman, Wagner, Cameto, & Knockey (2009) found that only 45% of students with disabilities attended any type of postsecondary education within four years of leaving school. They also reported that although 73% of students with disabilities reported being employed sometime after exiting school, only 58% were doing so full time. Finally, Newman et al. found only 25% of students with disabilities lived independently within four years after high school.

Given the heterogeneous nature of students with disabilities, often post-school outcomes are disaggregated by disability category (e.g., students with learning disabilities or autism spectrum disorder) to understand the different experiences. Previous research on outcomes for students with autism spectrum disorder (ASD), specifically, suggests less positive post-school experiences than students with disabilities in general. Shattuck, Narendorf,
Cooper, Sterzing, Wagner, & Taylor (2012) found that within six years of exiting high school, only 55.1% of students with ASD were ever employed for pay and 34.7% had ever attended a two- or-four year college. In contrast, approximately one-third of students with ASD have been neither employed nor attending postsecondary education within six years of leaving high school. Students with ASD also report low rates of independent living; Newman et al. (2011) found students with ASD experienced the lowest rates of independent living (i.e., not living with parents, guardians or another family member, aside from a spouse). Anderson, Shattuck, Cooper, Roux, and Wagner (2014) reported that less than one-fifth of students with ASD had ever lived independently after high school. These outcomes are disconcerting; additional research is needed and warranted on the post-school outcomes of individuals with ASD (Roux et al., 2013).

**Post-School Outcomes across Time**

Typically, one assumes the longer s/he is out of high school, the better his/her outcomes. In other words, it is logical to assume that one would make more money the longer one is out of high school – given additional time to obtain full-time employment and/or graduate from post-secondary education – as well as be more likely to live on one’s own (Carnevale, 2013). These are not unique expectations, but likely universal expectations for students with and without disabilities, although patterns are shaped by societal context (e.g., recessions) and generational factors (e.g., millennials vs. Generation X; The Council of Economic Advisers, 2014). However, one presumes most individuals expect their lives will improve the longer one is out of high school.

Previous researchers suggested a larger percentage of students with disabilities report experiencing adult life outcomes the longer they are out of school. For example, 24.7% of students with disabilities report living independently within four years of exiting high school, as compared to 35.7% of students with disabilities within six years and 44.7% within eight years. Likewise, the percentage of students with disabilities who indicate ever attending postsecondary education increased the longer the students were out of school, going from 44.7% (within four years) to 54.9% (within six years) and 60.1% (within eight years) (Newman et al., 2009; Newman et al., 2011; Sanford et al., 2011). However, the pattern was inconsistent for being currently employed, increasing from with four years of high school to within six years of high school (56.8% and 71.1%, respectively) and dropping for within eight years of high school (60.2%). For specifically students with mild intellectual disability, researchers also found inconsistent patterns for improvement of post-school outcomes the longer students were out of high school (Bouck, 2014). Yet, little-to-no research exists which explores the post-school outcome data pattern for individuals with ASD.

This particular research project – representing a secondary analysis of the National Longitudinal Transition Study-2 (NLTS2) data – sought to explore the relationship between length of time from exiting school and post-school outcomes for students with ASD. Given the unique characteristics of students with ASD relative to employment, postsecondary education, and independent living, the researchers felt it was important to isolate and explore the longitudinal nature of adult life outcomes for individuals with ASD. The specific research questions included (a) what are the immediate post-school outcomes of students with ASD; (b) what are the longer-term post-school outcomes of students with ASD; and (c) how do longer-term outcomes of students with ASD compare to the more immediate outcomes?

**Method**

In compliance with the regulations from the United States Department of Education Institute of Education Sciences (IES), no data for which the raw, unweighted sample size is less than three are reported. No raw data are reported in this article; data are reported as weighted using the mechanism provided for the NLTS2 by the original data collectors – SRI International (see Javitz & Wagner, 2003; Wagner, Newman, Cameto, Garza, & Levine, 2005 for a more in-depth discussion of weighting the data). Each survey has weights for each case within the database; the weighting accounts for the sample in the data within the
larger population from participating schools and districts (IES, n.d.). Weighting the data allows for a discussion of the population rather than the sample; the weighted data were analyzed using the Complex Samples package within SPSS.

Participants

A total of 4,665 secondary students with ASD are represented within these data. The majority of those individuals were male (93.8%, SE 1.9). The majority were also Caucasian (58.7%, SE 8.8), followed by African-American (36.7%, SE 8.5), Asian (2.2%, SE 1.7) and Hispanic (2.1%, SE 1.3). Given the focus on post-school outcomes, the majority of students were 17–18 years of age when in school (56%, SE 8.9), followed by 14 (19.1%, SE 3.7), 16 (16%, SE 4.1) and then 15 (8.8, SE 2.4). Although the majority of students identified as native English speakers (68%, SE 8.1), 1.3% (SE 0.3) indicated they were English language learners or bilingual and 30.8% (SE 8.0) did not produce verbal speech, as reported by parents or students themselves. The majority of the students were from families with annual income between $25,000 and $50,000 (54.8%, SE 10.3), followed by greater than $50,000 (28.3%, SE 6.7) and then less than $25,000 (16.8%, SE 7.9). Over half of the students lived in suburban communities (60.4%, SE 8.7), followed by urban (36.5%, SE 8.1) and then rural (3.1%, SE 1.3).

Data Collection

Data from this secondary analysis of the NLTS2 came from waves 1–4 of original data collection. Each wave represented a two-year period of data collection; the original NLTS2 data collection occurred across 10 years and five waves. Wave 1 data were collected in 2001 and 2002; wave 4 data collected in 2006 and 2007. Data from wave 1 and wave 2 represent in-school experiences and data from waves 2, 3, and 4 represent post-school experiences. Hence, the post-school experiences are discussed as within two years (waves 2 and 3), within four years (waves 3 and 4), and within six years of exiting high school (wave 4).

The data for the secondary analysis came from two of the six types of data collection: the parent/youth survey and the school program survey. The parent/youth survey was typically a 60-minute phone interview, completed by parents in wave 1 but, generally, by students in subsequent waves. However, if a student was unable to respond to the questions, a parent completed the interview in waves 2–4. Also, if participation in a phone interview was not possible, parents and/or youth were mailed a survey. The parent/youth survey provided demographic variables (e.g., gender, ethnicity) as well as variables representing the post-school experiences (e.g., employment, post-secondary education). The school program survey was a mail survey completed by the teacher most familiar with a student’s program. The school program survey solicited information relative to a student’s school experiences, such as curriculum and transition planning as well as demographics.

Procedure

To complete the secondary analysis, the researchers determined the variables needed to answer the research questions from the two survey instruments: the parent/youth survey (i.e., demographics and post-school experiences) and the school program survey (i.e., demographics). In terms of post-school experiences, the authors sought to represent independent living (i.e., living independently or dependently), employment (i.e., employed – defined as having a paid job, full time/part time employment, wage), and post-secondary education (i.e., attending and earning a diploma from four-year, community college, and/or vocational/technical school). Next, the researchers created in-school and post-school databases from the respective surveys; variables not used in the secondary analysis were deleted. The authors created in-school databases for waves 1 and 2 by first creating separate in-school databases for wave 1 for both parent/youth and school program surveys and then for both in wave 2. The two wave one in-school databases were merged together as were the two in-school databases from wave 2, resulting in a complete wave 1 in-school database and a complete wave 2 in-school database. The authors then created separate out-of-school parent/youth databases for waves 2, 3, and 4. Next, the authors merged databases
to represent in school in wave 1 and out in waves 2 (within two years), 3 (within four years) and 4 (within six years of high school); the same was done for the in school in wave 2 and out in waves 3 (within two years) and 4 (within four years of high school). The authors used Complex Samples with SPSS 22 to merge via cases. To create one database, the authors then renamed all the variables within the two in and out databases to be identical and merged the two databases with Complex Samples via variables.

Data Analysis

To answer the research questions, the authors used frequency distributions and a test equivalent to a $F$-test. All analyses were conducted with SPSS 22 using Complex Samples (SPSS 22) and Excel (the equivalency to a $F$-test). Specifically, to answer research questions 1 and 2 – the immediate (i.e., within two years) and longer-term post-school outcomes (i.e., within four and six years) of students with ASD – the authors conducted frequency distributions on the variables of interest: attending and earning a diploma from (a) a community college, (b) vocational/technical school, and (c) a four-year institution; ever having a paid job within the period between surveys (i.e., generally two years), currently having a paid job; living independently; hourly wage; working full or part time; liking work; who found individual his/her job; and how one gets oneself to work (i.e., drives self, rides with family, uses public transportation, or walks/rides the bus). Please note, that due to student or parent preference, inherent skip logic within the survey, and attrition, not every question was asked and/or answered. Hence, the frequencies as reported are based out of the weighted number of individuals who responded to that question.

To answer the third research question – how the longer-term outcomes of students with ASD compare to the more immediate outcomes – the authors used the equivalent to an $F$-test provided with the NLTS2 restricted use data from the IES and SRI International to determine statistically significant differences between groups. The $F$-test equivalent, conducted within Excel, allowed the authors to input the frequencies and standard errors for two groups and determine a statistically significant difference. Use of the $F$-test equivalent assessment allowed the researchers to compare if the variances in two populations were equal. For the purposes of this secondary analysis, differences were compared between outcomes for students with ASD within two years and four years, within two years and six years and within four years and six years. The following post-school outcomes between the years were compared: ever paid job, current paid job, independent living, attended community college, attended four-year college and attended vocational/technical school.

Results

The majority of student with ASD who were out of school were out because they graduated (87.2%, SE 3.2). Others were out because they dropped out or stopped going (7.5% SE 2.6), some reason not specifically asked in the survey (3.0% SE 1.0) (i.e., took test to receive diploma/certificate, dropped out or stopped out, permanently expelled, or graduated) or took a test to receive a diploma or certificate (1.6% SE 1.2).

Post-Secondary Education

Between one-fourth and one-third of students with ASD attended some form of post-secondary education within two, within four (two-to-four), and within six (four-to-six) years after exiting high school: 27.5% (SE 6.8), 30.6% (SE 7.4), and 29.2% (SE 6.9), respectively. Of the post-secondary education options, the most frequently reported was attending a community college (see Table 1). Attendance at community colleges experienced an increase in frequency the longer students were out of school 23.3% (SE 4.8) of students with ASD attended within six years, 20.0% (SE 4.9) within four years, and 15.1% (SE 4.4) within two years out of school. Attendance at four-year institutions also increased the longer students with ASD was out of school (i.e., 15.8%, SE 4.9 within six years of high school). In contrast, a decreasing percentage of students attended vocational/technical school the longer they were of school; the highest frequency was within two years of high school (10.2%, SE 4.0) and decreasing to 5.7% (SE 4.0).
(2.6) within six years of high school exit. Not surprisingly, the longer one was out of high school, the higher the frequency that those who attended earned a diploma (refer to Table 1). The highest frequency of students with ASD earned a diploma from postsecondary education institute when out of high school within six years.

Employment

Students with ASD reported an increased frequency of being both currently employed and ever employed within the wave of data collection the longer they were out of school (refer to Table 1). The highest frequency of students with ASD earned a diploma from postsecondary education institute when out of high school within six years.

Independent Living

A relatively small percentage of students with ASD reporting living independently – defined in this secondary analysis as living on one’s own, living with a spouse or roommate, or living in a college or military dorm – throughout the post-school years examined. The high-

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**TABLE 1**

Post-school Outcomes: Postsecondary Education, Employment, and Independent Living

<table>
<thead>
<tr>
<th></th>
<th>Attend CC</th>
<th>Diploma CC</th>
<th>Attend Voc</th>
<th>Diploma Voc</th>
<th>Attend 4-year</th>
<th>Diploma 4-year</th>
<th>Paid Job</th>
<th>Current Paid Job</th>
<th>Ind. Living</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Within 2 Years</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>15.1</td>
<td>—</td>
<td>10.2</td>
<td>—</td>
<td>7.2</td>
<td>0</td>
<td>30.4</td>
<td>17.1</td>
<td>3.1</td>
</tr>
<tr>
<td>(SE)</td>
<td>(4.4)</td>
<td>(4.0)</td>
<td>(2.4)</td>
<td>(5.5)</td>
<td>(4.1)</td>
<td>(1.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>4360</td>
<td>576</td>
<td>4400</td>
<td>432</td>
<td>4368</td>
<td>274</td>
<td>3268</td>
<td>3268</td>
<td>3737</td>
</tr>
<tr>
<td><strong>Within 4 Years</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>20.0</td>
<td>19.4</td>
<td>6.6</td>
<td>0</td>
<td>10.8</td>
<td>0</td>
<td>46.1</td>
<td>63.9</td>
<td>23.4</td>
</tr>
<tr>
<td>(SE)</td>
<td>(4.9)</td>
<td>(13.7)</td>
<td>(2.0)</td>
<td>(4.1)</td>
<td>(12.4)</td>
<td>(9.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>4307</td>
<td>815</td>
<td>4288</td>
<td>224</td>
<td>4307</td>
<td>441</td>
<td>4006</td>
<td>4201</td>
<td>4318</td>
</tr>
<tr>
<td><strong>Within 6 Years</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>23.3</td>
<td>36.1</td>
<td>5.7</td>
<td>30.9</td>
<td>15.8</td>
<td>49.7</td>
<td>84.7</td>
<td>52.6</td>
<td>4.4</td>
</tr>
<tr>
<td>(SE)</td>
<td>(5.8)</td>
<td>(10.9)</td>
<td>(2.6)</td>
<td>(12.9)</td>
<td>(4.8)</td>
<td>(15.1)</td>
<td>(4.4)</td>
<td>(10.7)</td>
<td>(1.6)</td>
</tr>
<tr>
<td>N</td>
<td>4303</td>
<td>1014</td>
<td>4260</td>
<td>328</td>
<td>4260</td>
<td>653</td>
<td>4240</td>
<td>4229</td>
<td>4303</td>
</tr>
</tbody>
</table>

*Note: All percentages are based on the number of weighted responses; not all individuals responded to each question. The percent of students who received a diploma is based on the number who both indicated they attended and who responded to the question. Dashes represent that an insufficient raw numbers of cases existed to report the data, consistent with the specification of the IES.*
est rate of independent living occurred when students were within four years of exiting high school (23.4%, SE 5.2); the frequencies for within two years and within six years were both less than 5%.

**Differences in Outcomes across Time**

When analyzing for statistically significant differences in the frequencies of outcomes across the three points in time, none were found for attending any of the three post-secondary education options. Statistically significant differences were found for having a paid job any time within the time frame and for currently having a paid job. Statistically significant differences were found for having a paid job at some point during the two-year wave when comparing outcomes within two years of exiting school and within six years of exiting school (F = 59.42, p < .001) and within four years of exiting school and within six years of exiting school (F = 8.61, p < .01). Statistically significant differences were also found for students with ASD with regards to having a job at the time of data collection when comparing the frequencies for both within two years and within four years (F = 19.75, p < .001) and for within two years and within six years (F = 9.60, p < .01). Finally, the frequencies for living independently were statistically significantly different for both within two years and within four years (F = 13.77, p < .001) and within four years and within six years (F = 12.2, p < .001).

**Discussion**

This study represented a secondary analysis of the NLTS2 aimed at understanding the immediate and long-term post-school outcomes of students with ASD and the relationship among those outcomes. The findings suggest the longer an individual with ASD is out of school, the more likely s/he is to both attend and then graduate from most all forms of post-secondary education. The same is also generally true for having a paid job – both at the time of data collection and ever within the two-year window period. However, the results for independent living, earning more than minimum wage, and working full-time tell a different – and more confusing – story for individuals with ASD.
From a positive perspective, students with ASD were employed at the time of data collection at a rate of over 50% when out of school more than two years. However, the discrepancy between being ever employed throughout the time frame examined and being currently employed is concerning. For example, 84.7% of adults with ASD reported having a job at some point within six years after high school, yet only 52.6% were currently employed. These results suggest the need to more critically examine post-school services provided to individuals with ASD relative to employment. They also suggest value in secondary schools collaborating earlier and to a greater extent with post-school agencies, such as vocational rehabilitation (Wilczynski, Trammell, & Clarke, 2013). Perhaps adults with ASD need additional support in keeping a job, outside of just getting a job. Shattuck et al. (2012) suggested a key element in supporting students with ASD with employment was to carefully match work experiences to an individual’s area of strength. Also, it is also important to ensure that students with ASD leave high school with as many soft vocational skills, such as social skills, as possible, given the importance of these skills in obtaining and maintaining employment (Wilczynski et al., 2013). When these services are not provided or skills are not obtained in high school, it becomes critical that individuals with ASD get access to services and then acquire the services as adults, such as through vocational rehabilitation and/or a state’s Developmental Disability Agency (Simonsen & Neubert, 2013).

Also positive were the increasing number of individuals with ASD who attended a community college or a four-year institution the longer they were out of school, and the increasing frequency of individuals who earned a diploma from the institutions they attended. While one could suggest that rates of post-secondary education participation were low for adults with ASD, they were actually higher than other populations (see Table 3 for a comparison of some outcomes for students with ASD to other individuals with disabilities). Frequencies of postsecondary education attendance of 27.5% for within two years of high school exit, 30.6% for within four years, and 29.2% for within six years is higher than consistently reported with previous research (Shattuck et al., 2012; Wehman et al., 2014). However, the results suggest perhaps the need for additional supports to help adults with ASD complete their postsecondary education.

It is important to note that much of the postsecondary education data occurred prior to the increase in postsecondary education options and programs for individuals with disabilities, and specifically students with ASD. As evident on ThinkCollege (2016), there are now postsecondary education programs to support students with ASD specifically. These programs are designed to provide individuals with ASD opportunities to participate in post-secondary education outside of the traditional disability services offered on college campuses to any individuals with a disability following Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. The programs highlighted on ThinkCollege provide unique supports and services to students with ASD for whom education beyond high school might not be possible or presents large challenges (Hendrickson, Carson, Woods-Goves, Mendenhall, & Scheidecker, 2013). For example, postsecondary education programs targeting students with ASD often include specific supports focused on the social needs – including socialization and navigating social environment – of college of students with ASD as well as daily living skills (Cullen, 2015). Social communication challenges and supports are often noted as a major issue for individuals with ASD in terms of accessing and finding success in postsecondary educational settings (Zager & Alpern, 2010).

As one might predict, the rates of earning a diploma from a postsecondary institution increased the longer an individual with ASD was out of school. Yet, less than 50% of students who attended an institution of postsecondary education earned a diploma within six years. Additional supports and services for students with ASD should be investigated for both high school as well as post-secondary to increase student opportunities for the ultimate success of graduating. It is insufficient to attend; students need to earn a diploma – or certificate – from postsecondary education institutions. It is also imperative that as models for college attendance – like those on ThinkCollege (2016) – increase postsecondary education access to more individuals with ASD that data
are gathered to understand the impact of such programs (Hendrickson et al., 2013; Zeedyk, Tipton, & Blacher, 2014). Data released on specialized college programs for students with ASD – and/or students with intellectual disability – to date suggest positive implications for such programs, including rates of employment and independent living (Ross, Marcell, Williams, & Carlson, 2013).

From this secondary analysis, outcomes for individuals with ASD were obtained with regards to earning more than minimum wage and working full time the longer one was out of school. These were true both for individuals with ASD as well as in comparison to individuals with other disabilities (refer to Table 3). Although disappointing and perhaps not fully reflective of the skills of individuals with ASD, the tendency towards part-time employment is not inconsistent with previous research for individuals with ASD (Holwerda, van der Klink, Groothoff, & Brouwer, 2012). It is also important to evaluate the data in light of context. For example, data for within six years of exiting high school was collected during 2006 and 2007. In the United States, 2006 and 2007 marked the beginning of a slowdown and eventual recession in the economy (Koba, 2011; Weller, 2006). If 2006 was marked by an economic slowdown, individuals with disabilities may have experienced a decreased in hours employed or accepted jobs with lower pay or obtained through other means, such as supported employment or even in sheltered workshops. Employment in sheltered workshops is associated with lower wages earned as well as working fewer hours (Cimera, 2011; Cimera, Wehman, West, & Burgess, 2012). Of course, another hypothesis outside of the impact of the economic slowdown is that the individuals who remained longer in the longitudinal study were qualitatively different than those who left the study. In other words, attrition was a factor and students for whom data are available during wave 4 – within six years of school exit – are different in key qualities that contribute to employment, such as IQ, service needs, functional and/or communica-

### Table 3

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Students with ASD</th>
<th>Students with Other Disabilities</th>
<th>Students without Disabilities</th>
<th>Students with MID (Bouck, 2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currently employed (within 2 years)</td>
<td>17.7%</td>
<td>42.9% (Wagner et al., 2005)</td>
<td>79.6% (Bureau of Labor Statistics, 2012)</td>
<td>36.7%</td>
</tr>
<tr>
<td>Currently employed (within 4 years)</td>
<td>63.9%</td>
<td>56.8% (Newman et al., 2009)</td>
<td>48.3%</td>
<td>53.9%</td>
</tr>
<tr>
<td>Full/part time employment (within 4 years)</td>
<td>8.8%</td>
<td>57.9% (Newman et al., 2009)</td>
<td>9.20 (U.S. Department of Labor, 2001)</td>
<td>$7.35</td>
</tr>
<tr>
<td>Hourly wage (within 4 years)</td>
<td>$5.46</td>
<td>$8.20 (Newman et al., 2009)</td>
<td>61.1% (IES, NCES, n.d.)</td>
<td>3.0%</td>
</tr>
<tr>
<td>4-year post-secondary attendance (within 4 years)</td>
<td>10.8%</td>
<td>45% (Newman et al., 2009)</td>
<td>4.0%</td>
<td>17.1% (within 2 years)</td>
</tr>
<tr>
<td>Post-secondary attendance</td>
<td>27.5% (within 2 years)</td>
<td>19.7% (Wagner et al., 2005)</td>
<td>19.2% (U.S. Department of Commerce, 2011)</td>
<td>17.1% (within 2 years)</td>
</tr>
<tr>
<td>Independent living</td>
<td>3.7% (within 2 years)</td>
<td>24.7% (Newman et al., 2009)</td>
<td>28% (Arnett, 1998)</td>
<td>30.9% (within 2 years) 17.5% (within 4 years)</td>
</tr>
</tbody>
</table>
tion needs, and family support (Holwerda et al., 2012; Roux et al., 2013). A final hypothesis is that during the years examined the full extent of support was not available. For example, as previously noted researchers are finding positive results for individuals with ASD engaged in specialized college programs that provide additional education and supports for individuals with ASD and/or intellectual disability after high school, including increased rates of employment (Ross et al., 2013).

Finally, the lower rates of independent living for individuals with ASD are consistent with previous research regarding the residential status of this population after high school (Anderson et al., 2014; Newman et al., 2011). Perhaps concerning with these data is the lack of apparent improvement from living status within two years of high school exit to within six years of high school exit. Despite the hypothesis that one’s outcomes – including independent living – would improve the longer one was out of school, these results were not consistently obtained for adults with ASD. As previously discussed, perhaps the individuals for whom the longest amount of data were collected represent individuals with more needs, and adults with ASD with more positive outcomes were lost due to the attrition within the original study. It could also be that the decrease in independent living within four years – in which an increase occurred from within two years – and within six years of being out of school reflect the changing societal economic times previously mentioned with regards to a downturn in full time employment and wage earnings. Like previously suggested for employment and post-secondary education, additional research regarding the factors contributing to the differing rates of post-school success is warranted. Also warranted is additional attention in practice to preparing high school students and adults with ASD, via rehabilitation services, for independent living and trying to provide the prerequisite skills for success (Anderson et al., 2014).

Limitations

This secondary data analysis of the NLTS2 is subject to the same limitations of the original NLTS2 data. Thus, there exist concerns about missing data from individuals not being asked and/or not responding to every question. In addition, attribution occurred within the original NLTS2 data collection. Related, given the secondary nature of the data, researchers were only able to analyze the existing data from the NLTS2 or what could be recoded from the original data. Hence, particular nuances of post-school outcomes might be missing given the lack of original data collection. Limitations also exist relative to the original data collection. For example, for the variable employment the surveys inquired about paid employment, but did not differentiate between integrated employment or employment in a sheltered workshop. Finally, the NLTS2 data are based on self-report – by the student, parent, or educator – and self-reported data can be biased.

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Effects of Self-Mediated Video Modeling Compared to Video Self-Prompting for Adolescents with Intellectual Disability

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Abstract: Self-instruction is a pivotal skill that promotes independence and self-determination by allowing individuals to independently access prompts during the acquisition of new skills while decreasing the need for support from another person. Self-mediated video modeling (SMVM) and video self-prompting (VSP) are two methods of video-based self-instruction in which individuals use technology to access visual support while practicing new skills. This study evaluated the efficiency of SMVM versus VSP to teach four high school females with intellectual disability art-related tasks in a school setting. An adapted alternating treatments design was used to compare the effects of SMVM and VSP on sessions to criterion and instructional time to criterion. Results indicated that both SMVM and VSP resulted in an increase in percentage of correct responses across all participants, but VSP tasks resulted in all participants reaching mastery criterion in the fewest sessions to criterion.

Self-instruction occurs when an individual uses resources available to learn a skill rather than relying on support or guidance provided directly by another person. The materials used for self-instruction may serve as the prompt to notify the learner of the step that should occur next in a sequence to complete a skill (Browder & Shapiro, 1985). Self-instruction promotes monitoring of one’s own behaviors when completing a task and is a form of self-directed learning. Teaching individuals how to self-instruct fosters self-determination (Agran & Wehmeyer, 2000). Self-determination is the ability to make decisions on one’s own life and plays a role in the success of an individual after graduating high school (Wehmeyer & Palmer, 2005). Self-instruction is a pivotal skill in that it allows individuals to not only learn one to three target behaviors, but instead, can potentially have collateral effects on several behaviors if the self-instruction skills generalize (Smith, Shepley, Alexander, & Ayres, 2015). For instance, once an individual learns how to self-instruct while learning to make a ham and cheese sandwich, they have acquired two skills (making a sandwich and self-instruction). While making a ham and cheese sandwich is valuable in a particular context, the skill of using a set of procedures to self-instruct creates opportunities to learn new skills.

Individuals with intellectual disability (ID) rely on teachers and other postsecondary instructors, such as job coaches, to predict and teach skills needed for obtaining and maintaining employment and for independent living. Teaching each skill in isolation that is required for future employment or community settings is an inefficient use of time and resources. Further, teaching all skills needed to fully integrate into one’s community and live independently is impossible. Instructors and teachers might consider teaching individuals how to self-instruct rather than teaching skills in isolation to maximize instruction time and increase independent skills (Smith et al., 2015). With web-based resources like YouTube, engaging in self-instruction has become more commonplace. For instance, if one needs to change a battery in a car, learn to fix a dishwasher, or even play an instrument, they can find instructional materials for free on YouTube. The challenge instructionally then...
is to teach individuals with ID to sift through the available instructional resources to identify a prompt corresponding to their needs.

Learning to self-instruct has the dual benefit of decreasing reliance on others while allowing a learner to pursue those topics of greatest need and interest to him or herself. Further, self-instruction may result in less stigmatization because rather than a teacher or job coach accompanying an individual into the natural environment, the learner can use mobile technology to self-instruct. Additionally, because self-instruction reduces dependence on instructors, instructors may have more time to dedicate to working with other learners or completing other duties.

Smith et al. (2015) reviewed the research on self-instruction strategies for individuals with ID that specifically resulted in generalization to novel skills. The results indicated that 56 of 57 included participants in the review learned at least one multi-step skill with a self-instructional strategy, “meaning the participant independently controlled and manipulated the [self-instruction] materials” (p. 21). The review identified three times within the experimental process in which individuals learned to self-instruct, including the use of history training prior to the baseline condition, teaching between baseline and intervention, or teaching during the intervention itself. Of the 56 individuals with ID that successfully acquired a self-instructional strategy, only 32 generalized this strategy to learn at least one additional multi-step skill. Smith et al. identified potential barriers related to generalization of self-instructional skills in the included studies. One example barrier was 7 of the 19 studies incorporated vocal directions to use the self-instruction tool in their task direction (e.g., “Restock the vending machine. Watch the video on your iPod”). Fundamentally, this means the learners did not have to discriminate on their own that they needed to use their self-instructional tools, rather they were directly coached by an instructor to do so. This, in some ways, defeats the end goal of self-instruction. Another issue that Smith et al. (2015) cited related to a lack of instruction for learners on how to search for and select self-instructional materials. In 18 of the 19 included studies, researchers directly loaded the self-instructional materials to the specific prompt required for task completion (e.g., the audio tape corresponding to target task was loaded in the cassette player or a video model demonstrating the targeted skill was loaded to a mobile device). An alternative would be teaching an individual to navigate through their self-instructional tool to locate a specific prompt among multiple available options. As technology has advanced, self-instructional tools have the potential to store multiple needed prompts to complete identified targeted skills.

The tools used by individuals with ID to self-instruct have evolved since the 1980s when researchers used books and picture prompts to teach a novel set of skills (e.g., Wacker & Berg, 1983, 1984). Self-instruction later incorporated more high-tech tools, such as cassette players with headphones to provide auditory prompting in the late 1990s (Trask-Tyler, Grossi, & Heward, 1994), and portable DVD players to promote self-mediated video modeling (SMVM) in the early 2000s (Mechling, Gast, & Fields, 2008; Mechling & Stephens, 2009). Beginning in 2009, handheld devices became more prevalent on the technology market; therefore, the tools used in self-instructional research followed suit. Mechling, Gast, and Seid (2009) taught participants SMVM using a Hewlett Packard iPAQ Pocket PC to complete cooking recipes. The first-generation Apple iPhone was released in 2007 (Apple Inc., 2007) and Bereznak, Ayres, Mechling, and Alexander (2012) first used it as a self-instructional tool for learners with ID and autism spectrum disorder (ASD) to complete vocational and independent living tasks.

Additional research has focused on video prompting self-instruction, or video self-prompting (VSP), in which a video of a task is separated into steps so that the individual views and then imitates a single step or a few steps of the task at a time, as opposed to the entire task in video modeling. Bereznak et al. (2012) evaluated the use VSP and taught three high school students how to pause and play video prompts of vocational and daily living skills such as using a washing machine, making noodles, and using a copy machine. After each step in the task analysis, the video displayed a stop sign for 4 s signaling to the participant to pause the video and complete the demonstrated step. Two of the three par-
Participants learned to pause and play the video prompts and reached mastery criterion of the various vocational and daily living tasks. Shepley, Spriggs, Samudre, and Elliott (2017) taught four middle school students with ID to self-instruct using a similar VSP format. The researchers created videos with embedded pause signs [similar to Bereznak et al.’s (2012) stop signs] to cue the participants to pause the video, complete the demonstrated step(s), and resume play to view additional video prompts. All participants learned to navigate the technology to find the necessary videos and pause/play videos using a system of least prompts instruction. After completing technology training, three of the four participants were able to self-instruct using video prompts to acquire a novel daily living task sequence (i.e., set the table, make noodles, and make a cup of punch). These studies provided support for video prompting as an effective self-instructional tool for learners of various ages with ID.

As mentioned above and represented in the published video-based instruction literature, videos can take one of two forms, video modeling and video prompting. Both methods have led to skill acquisition, yet it is important to assess efficiency of instruction to ensure instructional time is spent wisely, thus maximize outcomes for learners with ID. Mechling, Ayres, Bryant, and Foster (2014) compared VM and VP, along with continuous VM, in which the video looped until the researcher stopped the video. For all three forms of video instruction, the researcher delivered components of the self-instruction task analysis (e.g., setup the technology, pressed play on the videos); therefore, the participants did not fully self-instruct. Mechling et al. (2014) found that VP was most efficient (i.e., sessions, time, and errors to criterion) when acquiring chained tasks in which each step in the task analyses was completed only once. Taber-Doughty et al. (2011) compared the two self-instruction strategies, SMVM and VSP, in conjunction with system of least prompts instruction to teach cooking skills to middle school students with ID. The authors concluded that video modeling was more effective for two of the three included students and video prompting was more effective for the third participant. Given that researchers used system of least prompts instruction in conjunction with video-based instruction and sessions were not conducted to mastery criterion, additional research is needed to determine which method in isolation is more efficient.

Two forms of video-based self-instruction include video modeling and video prompting. Both strategies incorporate videos but are different in the presentation of the videos. Video prompting task analyzes the various steps of a skill and segments the video so that each clip serves as a prompt to complete that step of the skill. Video modeling displayed the entire targeted tasks as one video prior to allowing the learner to imitate the observed steps. While these various forms of self-instruction are both effective interventions (i.e., have resulted in acquisition of novel tasks) more information is necessary to determine the most efficient self-instructional method for individuals with ID. The purpose of this study was to compare the efficiency of self-instruction with mobile technology when presented as a SMVM and when presented as VSP. The research question was: Will self-instruction using SMVM or VSP result in more efficient instruction (i.e., rate of acquisition) for participants with ID?

Method

Participants and Setting

Four high school females ages 15 to 20 years old participated in the study. All participants attended a rural public high school and received daily instruction in a special education classroom. Through school eligibility, one participant was identified as having moderate ID (Meg), two with mild ID (Jo and Amy), and one with ASD and mild ID (Beth). Specific participant demographic information is located in Table 1. All participants demonstrated the prerequisite skills of attending to a task for 10 min, imitating a video model, receptively discriminating between five pictures, and fine motor skills that allowed navigation of an iPhone as well as the fine motor skills required for the target tasks. Additionally, all participants had previous experience with mobile technologies, and three had their own devices (e.g., iPod Touch). The study took place in a teacher workroom down the hall from the participants’ special education class-
room. Sessions were conducted in a one-to-one format at a table with four chairs. Doctoral-level special education students ran all sessions and collected data for each session.

Materials

Instructional materials. The researchers used two iPhone 4s loaded with video models and video prompts of the target tasks to provide video-based instruction to the participants. Videos were filmed from a performer’s point of view (Ayres & Langone, 2007) depicting two hands completing the target origami tasks, providing the same perspective of the task that participants would see as they complete the tasks themselves. Origami tasks were used to increase internal validity by reducing the likelihood that participants had previous exposure to the tasks and to equate task difficulty for precise comparison. Voice narration verbalizing the steps within the task analyses were added. Videos were uploaded to the iPhone and stored under the Videos application which was located in the top right corner of the iPhone home screen.

Task materials. Task materials for each condition consisted of a 15 cm × 15 cm origami paper (i.e., green for tree, red for heart, brown for cup). Data collection sheets were used in each session that allowed data collectors to track percentage of correct responses, sessions to criterion, instructional time to criterion, and procedural fidelity.

Technology Training

Following baseline sessions and prior to beginning the comparison condition, all participants were taught to initiate self-instruction by pulling the iPhone out of their pocket, navigate to the video corresponding to the task direction, view the video, and press pause/play if the screen displayed a pause sign. Videos and tasks used in technology training were different than those used in the experimental design. The training tasks involved nonsense and unpredictable folds in origami paper, meaning the end product did not result in an identifiable object or animal like traditional origami. These nonsense tasks were labeled by the color of the paper (e.g., “Make the origami purple shape”) to ensure the participant needed to self-instruct. These self-instructional steps were taught using a system of least prompts procedure in which the researcher provided a verbal prompt (e.g., “Press the videos icon”), followed by a gesture (e.g., pointing to the videos icons) if incorrect or no response, followed by a physical prompt (e.g., guiding the participant’s finger to press the videos icon) to ensure correct responding. Training was conducted until each participant performed two consecutive sessions at 100% independent correct responding for phone navigation steps for a SMVM task and for a VSP task, and then again for two consecutive sessions at 100% for a second novel SMVM and VSP task. See Table 2 for technology training data.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age*</th>
<th>School Eligibility</th>
<th>IQ</th>
<th>Adaptive Behavior Scale</th>
<th>Autism Rating Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meg</td>
<td>20.3</td>
<td>MoID</td>
<td>42</td>
<td>60</td>
<td>NA</td>
</tr>
<tr>
<td>Jo</td>
<td>15.1</td>
<td>MID; SLI</td>
<td>44</td>
<td>69</td>
<td>NA</td>
</tr>
<tr>
<td>Beth</td>
<td>18.0</td>
<td>ASD; MID; SLI</td>
<td>74</td>
<td>59</td>
<td>Very elevated range</td>
</tr>
<tr>
<td>Amy</td>
<td>16.3</td>
<td>MID; SLI</td>
<td>50</td>
<td>66</td>
<td>NA</td>
</tr>
</tbody>
</table>

Dependent Measures

Data were collected on three dependent variables: percentage of correct responses, sessions to criterion, and instructional time to criterion. For a response to be scored as correct, it had to be a topographically accurate response according to the task analysis, be initiated within 5 s of a discriminative stimulus, and completed within 15 s. Incorrect responses occurred due to latency errors (not initiating the step within 5 s), duration errors (not completing the step within 15 s), or topographical errors (not engaging in the correct action to complete the step). The number of correct responses was divided by the total number of responses and multiplied by 100 to obtain the percentage of correct responses per session (see Table 3 for task analyses of the targeted tasks). Sessions to criterion consisted of the number of instructional sessions required for a participant to reach 100% mastery per task. Instructional time to criterion was defined as the total time required during all instructional sessions for a given treatment. This was calculated by starting a stop watch after delivery of each task direction and stopping upon completion of the final step in each task.

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>Technology Training Sessions to Criterion and Time in Instruction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SMVM</strong></td>
<td><strong>VSP</strong></td>
</tr>
<tr>
<td>Sessions to Criterion</td>
<td>Sessions to Criterion</td>
</tr>
<tr>
<td>Total Duration in Instruction</td>
<td>Total Duration in Instruction</td>
</tr>
<tr>
<td>Task 1</td>
<td>Task 2</td>
</tr>
<tr>
<td>Meg</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6.25 m</td>
</tr>
<tr>
<td>Jo</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>5.52 m</td>
</tr>
<tr>
<td>Beth</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4.92 m</td>
</tr>
<tr>
<td>Amy</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>8.35 m</td>
</tr>
<tr>
<td>Mean</td>
<td>3.75</td>
</tr>
</tbody>
</table>

Note: SMVM = Self-mediated video modeling; VSP = Video self-prompting; m = minutes.

<table>
<thead>
<tr>
<th>TABLE 3</th>
<th>Task Analyses for Origami Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Task</strong></td>
<td><strong>Task Steps</strong></td>
</tr>
<tr>
<td>Cup</td>
<td>1. Fold one corner to opposite corner with brown side showing</td>
</tr>
<tr>
<td></td>
<td>2. Turn paper so point is at top</td>
</tr>
<tr>
<td></td>
<td>3. Fold top point of top paper down to flat edge</td>
</tr>
<tr>
<td></td>
<td>4. Unfold step 3</td>
</tr>
<tr>
<td></td>
<td>5. Fold left corner over to meet right side at crease</td>
</tr>
<tr>
<td></td>
<td>6. Fold right corner over to meet left side</td>
</tr>
<tr>
<td></td>
<td>7. Fold top flap down along horizontal line</td>
</tr>
<tr>
<td></td>
<td>8. Unfold step 7</td>
</tr>
<tr>
<td></td>
<td>9. Make an opening in cup and fold top flap into opening</td>
</tr>
<tr>
<td></td>
<td>10. Fold top point down over cup</td>
</tr>
<tr>
<td></td>
<td>11. Unfold step 10</td>
</tr>
<tr>
<td></td>
<td>12. Make an opening in cup top and fold flap into cup opening</td>
</tr>
<tr>
<td></td>
<td>13. Use fingers to open cup</td>
</tr>
<tr>
<td>Tree</td>
<td>1. Fold one corner to opposite corner with green side showing</td>
</tr>
<tr>
<td></td>
<td>2. Unfold step 1</td>
</tr>
<tr>
<td></td>
<td>3. Fold right point along mid-line</td>
</tr>
<tr>
<td></td>
<td>4. Fold left point along mid-line</td>
</tr>
<tr>
<td></td>
<td>5. Flip paper over</td>
</tr>
<tr>
<td></td>
<td>6. Fold right point along mid-line</td>
</tr>
<tr>
<td></td>
<td>7. Fold left point along mid-line</td>
</tr>
<tr>
<td></td>
<td>8. Flip paper over</td>
</tr>
<tr>
<td></td>
<td>9. Fold bottom point up to top point</td>
</tr>
<tr>
<td></td>
<td>10. Flip paper over</td>
</tr>
<tr>
<td></td>
<td>11. Fold top point down to edge so it hangs over around 1.5 inches</td>
</tr>
<tr>
<td></td>
<td>12. Fold bottom point up a little bit</td>
</tr>
<tr>
<td></td>
<td>13. Flip paper over</td>
</tr>
<tr>
<td>Heart</td>
<td>1. Fold one corner to opposite corner with red side showing</td>
</tr>
<tr>
<td></td>
<td>2. Turn paper so point is at top</td>
</tr>
<tr>
<td></td>
<td>3. Fold right corner up to top point</td>
</tr>
<tr>
<td></td>
<td>4. Fold left corner up to top point</td>
</tr>
<tr>
<td></td>
<td>5. Flip paper over</td>
</tr>
<tr>
<td></td>
<td>6. Fold top two flaps down to bottom point</td>
</tr>
<tr>
<td></td>
<td>7. Fold top right point to right corner along midline</td>
</tr>
<tr>
<td></td>
<td>8. Fold top left point to left corner along midline</td>
</tr>
<tr>
<td></td>
<td>9. Unfold steps 7 and 8</td>
</tr>
<tr>
<td></td>
<td>10. Open top right flap and fold in along mid-horizontal line</td>
</tr>
<tr>
<td></td>
<td>11. Open top left flap and fold in along mid-horizontal line</td>
</tr>
<tr>
<td></td>
<td>12. Fold top right point down</td>
</tr>
<tr>
<td></td>
<td>13. Fold top left point down</td>
</tr>
<tr>
<td></td>
<td>14. Fold in right corner a little bit</td>
</tr>
<tr>
<td></td>
<td>15. Fold in right top point a little bit</td>
</tr>
<tr>
<td></td>
<td>16. Fold in left corner a little bit</td>
</tr>
<tr>
<td></td>
<td>17. Fold in left point a little bit</td>
</tr>
<tr>
<td></td>
<td>18. Fold bottom two flaps up to center</td>
</tr>
<tr>
<td></td>
<td>19. Flip over and prop up heart</td>
</tr>
</tbody>
</table>
task analysis. The duration for each task was summarized to report total time in instruction with each independent variable.

A secondary observer collected inter-observer agreement (IOA) data and procedural fidelity (PF) data for a minimum of 20% of sessions in all conditions for each treatment. Inter-observer agreement was calculated using point-by-point agreement in which the number of agreements were divided by the number of agreements plus disagreements and multiplied by 100 (Ayres & Ledford, 2014) resulting in 100% IOA for all sessions. Procedural fidelity was collected on the following researcher behaviors: (a) correct responses received praised on a CRF schedule of reinforcement, (b) incorrect responses were corrected using a multiple opportunity probe, (c) the phone was in the participant’s pocket 3 to 10 min before sessions, (d) the correct task direction was delivered, (e) the correct origami paper was handed to the participant, (f) the timer was started following the task direction and stopped upon completion of the final step, and (g) researcher implemented multiple opportunity probe correctly including adhering to latency and duration time restraints and correcting incorrect steps out of view of the participant. PF was calculated by dividing the number of observed research behaviors by the number of planned researcher behaviors and multiplying by 100 (Gast, 2014). Mean PF was 99.8% across all sessions with a range of 97% to 100%.

Experimental Design

An adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985; Wolery, Gast, & Ledford, 2014) was used to compare the effects of SMVM to VSP. The design included a baseline phase to first establish student performance on the origami tasks for a minimum of three sessions or until stable (i.e., a decelerating or zero-celerating trend in the data path). The comparison condition of the study was initiated in which participants were asked to fold each of the three different origami figures. The SMVM and VSP tasks were counterbalanced across students, and the same task (i.e., origami heart) was used for the control set for all participants. Each participant was only exposed to one treatment per origami figure. The control condition was used to allow for an opportunity to replicate the demonstration of the effect of the more efficient instructional procedure and provide a more compelling case for a functional relation. The sequence (SMVM, VSP, and control) of tasks was randomized each day and all three sessions were conducted each day. Sessions were conducted three to five days a week with no more than one session for each task conducted a day. Following at least six sessions and the acquisition of at least one origami figure (100% of steps performed correctly with the instructional procedures), the comparison condition stopped and the replication condition began. In the replication condition, the treatment that resulted in the most rapid acquisition (based on the number of training sessions) was then applied to the control task, allowing for an opportunity to replicate the acquisition effects. If one of the tasks in the initial comparison failed to reach mastery criterion, the participant received additional instruction on that task with the treatment that was most effective (i.e., best treatment condition).

Procedure

General procedures. Three to ten min prior to running a session, the researcher gave the participant an iPhone, loaded with videos corresponding to that condition and participant, and asked them to place the phone in their pocket. This was done to replicate how the general population begins to self-instruct (Smith et al., 2016). Once seated at the table in the teacher workroom, the researcher delivered the task direction to (e.g., “Make an origami cup, use your phone if you want to”) while handing the participant the origami paper that corresponded with the task direction. For each task, participants were given 5 s to initiate, and if initiated, 15 s duration to complete each step. If participants failed to initiate or responded incorrectly, the researcher performed the step out of view of the participant and represented the paper to the participant so the following step could be performed (i.e., multiple opportunity probe; Cooper, Heron, & Heward, 2007). This continued until either the participant or the researcher completed the final step for each task. All correct steps
received general verbal praise (e.g., “Nice job”).

**Baseline.** Sessions followed general procedures. During baseline conditions, the videos loaded on the iPhone restated the task direction and showed a picture of the final product, but did not play any step by step videos to complete the targeted tasks.

**Comparison.** All sessions followed general procedures. During SMVM sessions, a video depicting the entire task, start to finish, was loaded in the iPhone. While watching the video model, attempts to fold along with the video were blocked in order to ensure VM was implemented as described in the literature, as opposed to simultaneous VM in which a learner imitates a video model while it is playing (Sancho, Sidener, Reeve, & Sidener, 2010; Taber-Doughty, Patton, & Brennan, 2008). To block, the researcher placed a hand on the origami paper until the video finished. During VSP sessions, videos included a 4 s pause sign between each step in the task analyses. This red and white pause symbol was accompanied by an audible “pause.” Attempts to fold along with the video were blocked by placing a hand on the paper until the participant pressed paused. If a participant continued to complete a step before viewing the corresponding video prompt, the researcher blocked this attempt by placing a hand on the origami paper and pointed to the phone. Control sessions were identical to baseline procedures. The comparison condition was conducted for a minimum of six sessions and until a treatment reached criterion of 100% correct responding for one session.

**Replication.** The treatment with the fewest sessions to criterion was applied to the control task to evaluate for intrasubject replication of treatment effects (Wolery et al., 2014). The same procedures were used as described in the comparison condition for that specific treatment. Replication sessions were conducted for a minimum of three sessions and until the participant reached criterion of 100% correct responding for one session.

**Best treatment.** If a participant did not reach criterion with both treatments during the comparison condition, the treatment with the fewest sessions to criterion (i.e., the best treatment) was applied to the task that did not reach criterion. This was conducted to assess if applying the best treatment to a task with previous intervention would produce therapeutic changes in participant’s behavior. The same procedures were used as described in the comparison condition for that specific treatment. Best treatment sessions were conducted for a minimum of three sessions and until the participant reached criterion of 100% correct responding for one session.

**Results**

Figures 1 and 2 demonstrate each participants’ correct responding for the SMVM, VSP, and control tasks. Visual analysis of the data revealed an increase in level for both SMVM and VSP tasks for all participants. Additionally, all participants reached mastery criterion on the VSP task and one participant reach mastery on both the VSP and the SMVM task. Overall, the fewest sessions to criterion for all participants was the VSP task, making it the best treatment based on the results of this study.

**Meg**

During baseline, Meg performed 5% (range 0–15%) of her SMVM task (origami tree), 21% (range 15–23%) of her VSP task (origami cup), and 11% of her control task (origami heart). During the comparison condition, she performed 44% (range 23–62%) SMVM task, 84% (range 54–100%) VSP task, and 20% (range 5–26%) control task. She reached criterion on her VSP task in eight sessions and was in VSP instruction for a total of 48.47 min until mastery, with each session lasting an average of 4.91 min.

VSP was introduced to the control task in the replication condition, resulting in an immediate change in level and an accelerating trend until reaching mastery in six sessions. Meg’s performance on the control task during the replication condition was 86% (range 74–100%) and lasted a total of 47.25 min (an average of 7.88 min per session). Lastly, VSP was applied to the SMVM task in the best treatment condition, resulting in 82% (range 69–100%) correct responding and reaching mastery in five sessions.
Beth

During baseline, Beth performed 18% (range 15–23%) of her SMVM task (origami tree), 9% (range 8–15%) of her VSP task (origami cup), and 24% (range 21–32%) of her control task (origami heart). During the comparison condition, she performed 87% (range 62–100%) SMVM task, 100% VSP task, and 32% (range 21–37%) control task. She reached criterion in four sessions using SMVW and reached criterion within one session using VSP. Regarding total time spent in instruction until mastery, Beth was in SMVM instruction for 18.47 min (an average of 4.62 min per session) and VSP for 5.82 min.

VSP was the more efficient instruction based on sessions to criterion and therefore was introduced to the control task in the replication condition, resulting in an immediate and abrupt change in level, reaching mastery in four sessions lasting a total of 33.58 min (an average of 8.40 min per session). Beth’s performance on the control task during the replication condition was 93% (range 89–100%).

Jo

In baseline, Jo performed 21% (range 8–38%) of her SMVM task (origami cup), 27% (range 15–38%) of her VSP task (origami tree), and 13% (range 11–16%) of her control task (origami heart). During the comparison condition, she performed 79% (range 54–92%) SMVM task, 94% (range 77–100%) VSP task, and 41% (range 21–47%) control task. She reached criterion with her VSP task in four sessions and was in VSP instruction to mastery for a total of 26.52 min, with each session lasting an average of 6.63 min.

VSP was introduced to the control task in the replication condition, resulting in an immediate change in level and an accelerating...
trend until reaching mastery in four sessions. Jo’s performance on the control task during the replication condition was 88% (range 74–100%) and lasted a total of 37.22 min (an average of 9.30 min per session). Lastly, VSP was applied to the SMVM task in the best treatment condition, resulting in 97% (range 92–100%) correct responding and reaching mastery in two sessions.

**Amy**

During baseline, Amy performed 5% (range 0–8%) of her SMVM task (origami cup), 18% (range 8–23%) of her VSP task (origami tree), and 21% (range 5–26%) of her control task (origami heart). During the comparison condition, she performed 64% (range 54–77%) SMVM task, 89% (range 77–100%) VSP task, and 43% (range 37–53%) control task. She reached criterion with her VSP task in five sessions and was in VSP instruction for a total of 40.33 min, with each session lasting an average of 8.07 min.

VSP was introduced to the control task in the replication condition, resulting in an immediate change in level and an accelerating trend until reaching mastery in six sessions. Amy’s performance on the control task during the replication condition was 89% (range 79–100%) and lasted a total of 64.17 min (an average of 10.69 min per session). Lastly, VSP was applied to the SMVM task in the best treatment condition, resulting in 86% (range 77–100%) correct responding and reaching mastery in seven sessions.

**Discussion**

Overall VSP resulted in independent task performance for all participants and was the more efficient self-instructional tool. These results are consistent with the literature comparing teacher-directed video modeling to video...
prompting (Cannella-Malone et al., 2011; Cannella-Malone et al., 2006; Mechling et al., 2014), in that video prompting was more efficient in terms of the number of sessions to criterion. Few studies in the literature report the time required to training in self instruction. While VSP may take more time to initially train, (for example, in this study it took 6 min for SMVM compared to 10 min for VSP); however, in the long term, the learner will acquire other novel skills in fewer sessions than if learned using SMVM. However, it should be noted that learning, or skill mastery, has not truly occurred until the learner acquires the skills, demonstrates the skill with fluency similar to that of a same-age peer, generalizes the skills to new stimuli, and maintains the skill after instruction ends (Cooper et al., 2007). This study only evaluated the efficiency of that first learning phase, acquisition, and did not account for the other phases which are equally important components of learning.

In 2015, Smith et al. reported training procedures to teach self-instruction but noted that they did not teach two critical skills. They did not evaluate methods to teach initiation steps and locating video supports. These two skills are critical for generalization and use in the natural environment. The present study provides some evidence suggesting that system of least prompts can be used to teach these steps.

Limitations

Readers should interpret the results of this study in the context of several limitations. First, even though SDVM and VSP were student mediated, the researcher still blocked errors and provided praise on a CRF schedule. Therefore, the students’ skill acquisition did not occur totally independent of an instructor. Second, mastery criterion was only set at one session at 100% correct, increasing this to require more demonstrations at 100% correct would help to evaluate for chance responding on some steps. Relatedly, the condition not reaching mastery level should have been run until the student either mastered with that task or performance plateaued. This would have provided a more detailed comparison (i.e., total difference in time to mastery) and would have provided some additional assurance that the first task, once mastered, maintained at that level. Finally, from a design perspective, the multiple opportunity probes appeared to result in a slight accelerating trend for all participants in the control condition. This indicates that repeated exposure of the steps in sequence will result in at least some gradual growth (testing threat; Alexander, Ayres, Shepley, Smith, & Ledford, 2017; Alexander, Smith, Mataras, Shepley, & Ayres, 2015).

Implications for Research

In terms of research on self-instruction, this study moves closer to providing a methodology to teach truly independent self-instruction, in that the participants were taught how to initiate their device, select the video corresponding to the task direction, and play (and pause during VP) videos independent of instructor support. Researchers exploring generalization and self-instruction may consider examining more closely how to eliminate the need for any instructor engagement. For example, evaluating means for self-correction/self-evaluation of steps so that a teacher would not be required to interrupt errors. Additionally, building in means for self-reinforcement or conditioning task completion alone as a reinforcer. To fully manualize a means for self-instruction, more work is required to identify appropriate ways for technology to substitute into these traditional teacher roles.

If researchers can design a self-contained system that prompts, provides corrective feedback, and reinforces, which is also accessible to individuals with disabilities, this would mark a step toward a prosthetic technology that can reshape lives. The ability to pursue one’s own interests and learn what one wants to learn, would increase autonomy for individuals with ID and expand opportunities in leisure, work, and independent living.

Implications for Teaching

In a classroom or therapeutic context, preparing self-instructional materials and teaching learners to control some aspects of their instruction can free teachers or therapists to reallocate their time to other tasks. In a class-
room, students’ independent work time becomes an opportunity where they can instruct themselves and learn new skills rather than only work on fluency or practicing skills that are already partially in their repertoire. Job coaches and therapists can invest less time in teaching specific vocational tasks and instead focus on more nuanced things like social skills.

Teachers can also apply this same methodology to other multi-step tasks that are part of the general education curriculum. For example, a middle school student learning to solve algebraic expressions could, in theory, self-instruct on the steps required to solve the problem by using VSP. This could allow a teacher to structure a session differently if individual students could access the learning supports they needed via technology. The technology exists in the classroom and a great many video-based resources exist online. Vetting these resources and constructing a system to provide these means to students after they learn to self-instruct could help maximize learning time and engagement in schools.

References


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Abstract: Wong et al. (2014) conducted a comprehensive review of the literature published between 1990 and 2011 to identify practices for children, adolescents, and young adults diagnosed with autism spectrum disorders (ASD) that had sufficient empirical support to be considered evidence-based. Behavior momentum interventions (BMI), or high-probability request sequence, was identified as a focused intervention practice with some support due to an insufficient number of participants. The purpose of this review was to expand on these findings from Wong et al. (2014) to determine if high-probability request sequence interventions can be considered an evidence-based practice for individuals with ASD. Results indicated the intervention can be considered an EBP for individuals with ASD. Implications for practice and suggestions for future research are discussed.

The Autism and Developmental Disabilities Monitoring Network estimates that 1 in 68 children are identified as having an autism spectrum disorder (Christensen et al., 2016). According to the American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-V), the diagnostic criteria for autism spectrum disorder (ASD) includes persistent deficits across a range of severity in social communication and social interaction and restricted, repetitive patterns of behavior, interests, or activities (2013). Due to the complex nature of an ASD diagnosis, the increased prevalence of the disorder, and the number of unsupported and controversial interventions available (Simpson et al., 2005), the need to identify effective and evidence-based educational and therapeutic services for this population has intensified (Odom, Collet-Klingenberg, Rogers, & Hatton, 2010).

Federal legislation (ESSA, 2015; IDEA, 2004) requires educators and service providers to use effective interventions that are based on scientifically validated research. The What Works Clearinghouse (WWC), funded by the Institute for Education Science, has made progress identifying evidence-based practices (EBP) for general education; however, the identification of EBP for children and youth with ASD has been slower to emerge due to the omission of single-subject experimental design studies as an acceptable form of empirical evidence (Odom et al., 2010). While there is not a universally agreed-on set of standards, research in special education and autism has made progress in identifying practices that are considered evidence-based (Odom et al., 2010).

The National Standards Project (NSP) of the National Autism Center (NAC, 2009) was one of the first projects to identify evidence-based practices for individuals with ASD. The NSP developed a model for identifying the level of research support that was currently available on academic and behavioral interventions for students with ASD. The authors reviewed previously established guidelines for examining evidence-based practices from other related fields (e.g., America Psychological Association Presidential Task Force on Evidence-Based Practice, 2005; Kratochwill & Stoiber, 2002), examined publications about EBPs (e.g., Chambless et al., 1998; Horner et al., 2005), and consulted with 25 experts who attended planning sessions. After a rigorous
review process, the NSP identified a classification system based on strength of evidence to support the targeted practice (i.e., established, emerging, unestablished, ineffective/harmful). A total of 775 research studies published between 1957 and 2007 were reviewed and analyzed. The NSP identified 11 established treatments (i.e., antecedent packages, behavioral packages, comprehensive behavioral treatment for young children, joint attention intervention, modeling, naturalistic teaching strategies, peer training packages, pivotal response treatments, schedules, self-management, story-based intervention packages) that are effective in addressing the core characteristics associated with ASD (NAC, 2009). In addition to 11 established treatments, 22 additional practices were identified as emerging treatments for individuals with ASD.

In addition to the review conducted by the NSP, in 2010 the National Professional Development Center (NPDC) on ASD developed a process for reviewing literature and establishing criteria for identifying EBPs for individuals with ASD (Odom et al., 2010). Including published research from 1997 to 2007, the NPDC reviewed 775 studies that identified 24 focused intervention practices (i.e., prompting, reinforcement, task analysis and chaining, time delay, computer-aided instruction, discrete trial training, naturalistic interventions, parent-implemented interventions, peer-mediated instruction/intervention, picture exchange communication system, pivotal response training, functional behavior assessment, stimulus control/environmental modification, response interruption/redirection, functional communication training, extinction, differential reinforcement, self-management, social narratives, social skills training groups, structured work systems, video modeling, visual supports, speech-generating devices). The authors determined these 24 practices had sufficient evidence to be considered EBPs (Odom et al., 2010).

Building on their previous findings (Odom et al., 2010), the NPDC updated and expanded their review with more rigorous criteria in 2014 (Wong et al., 2014). The authors reviewed studies published from 1990 to 2011 and developed a new evaluation process incorporating adapted protocols drawing from the quality indicators developed for group design (Gersten et al., 2005), single-case design (Horner et al., 2005), and the criteria set by WWC and NSP. Studies that were included in the review (a) targeted individuals with ASD between birth and 22 years of age; (b) were behavioral, developmental, or educational interventions implemented in typical educational intervention settings (i.e., school, home, community); (c) compared interventions to no intervention or alternative intervention conditions; (d) had behavioral, developmental, or academic outcomes; and (e) used an experimental group, quasi-experimental group, or single-case design (Wong et al., 2014). For a focused intervention to be considered evidence-based, the following qualification criteria had to be met: (a) at least two high quality experimental or quasi-experimental group design studies conducted by at least two different researchers or research groups, or (b) at least five high quality single-case design studies conducted by at least three different researchers or research groups having a total of at least 20 participants across studies, or (c) a combination of at least one high quality experimental or quasi-experimental group design article and at least three high quality single-case design studies conducted by at least two different research groups (Wong et al., 2014). After identifying and reviewing a total of 456 published studies that met the criteria for inclusion, this review identified 27 EBPs (i.e., antecedent interventions, cognitive behavioral interventions, differential reinforcement, discrete trial training, exercise, extinction, functional behavior assessment, functional communication training, modeling, naturalistic intervention, parent-implemented intervention, peer-mediated intervention and intervention, picture exchange communication system, pivotal response training, prompting, reinforcement, response interruption/redirection, scripting, self-management, social narratives, social skills training, structured play group, task analysis, technology-aided instruction and intervention, time delay, video modeling, and visual support). In addition to identifying 27 EBPs, this review found 24 other focused intervention practices were identified as having some support, but lacked the methodological criteria used in the review.

One focused intervention practice identified by Wong et al. (2014) as having some empirical support was behavioral momentum interventions. Wong et al. defined behavior
momentum interventions as, “the organization of behavior expectations in a sequence in which low probability behaviors are embedded in a series of high probability behaviors to increase the occurrence of the low-p behaviors” (p. 25). While the field of behavior analysis has used a variety of terms to refer to this intervention (e.g., interspersed requests, Horner & Day, 1991; pre-task requests, Singer, Singer, & Horner, 1987; behavioral momentum, Mace & Belfiore, 1990, high-probability request sequence, Mace et al., 1988), the term high-probability request sequence (HPRS) has become the recommended term for this practice (Cooper, Heron, & Heward, 2007).

HPRS have typically involved the presentation of easy-to-follow, or previously mastered requests (i.e., on average four) with a high probability of compliance (i.e., high-p) immediately before presenting a request that has been identified as having a low probability (low-p) of compliance (Lee, 2005; Sprague & Horner, 1990). HPRS provides a non-aversive antecedent-based procedure that has empirical support as being an effective intervention for increasing compliance across a variety of settings and behaviors (Lee, 2005).

While Wong et al. (2014) found behavioral momentum interventions have support from a sufficient number of single-case design studies (Banda & Kubina, 2006; Davis, Brady, Hamilton, Evoy & Williams, 1994; Davis, Brady, Williams, & Hamilton, 1992; Ducharme, Lucas, & Pontes, 1994; Houlihan, Jacobson, & Brandon, 1994; Jung, Sainato, & Davis, 2008; Patel et al., 2007; Riviere, Becquet, Peltrut, Facon, & Darcheville, 2011; Romano & Roll, 2000); however, this collection of studies did not include a sufficient number of participants (i.e., 20 or more) across studies to be considered evidence-based. Furthermore, their review was more broadly applied to research on strategies based on the concept of behavioral momentum rather than the specific HPRS strategy. Therefore, the purpose of this comprehensive literature review was to expand the findings of Wong et al. (2014) to include the literature on HPRS published from 2012–2016 using the evidence-based criteria developed by Wong et al. (2014) and to determine if HPRS can be considered an EBP for individuals with ASD.

Method

A comprehensive review of the literature published from 2012 to 2016 was conducted to extend the review by Wong et al. (2014) to evaluate the effects of HPRS on the behavioral, developmental, or academic outcomes for individuals with ASD between birth and 22 years of age. This extended review involved a direct replication of Wong and colleagues’ (2014) procedures for article identification and selection, inclusion/exclusion criteria, and review process.

Inclusion Criteria

Participants and outcomes. To qualify for the review, a study had to include participants between birth and 22 years of age and diagnosed with ASD. Participants who were identified as having comorbid diagnoses (e.g., autism and intellectual disability, Davis et al., 1992) were included in the review. HPRS interventions studies reporting behavioral, developmental, or academic outcomes were included in this review.

HPRS interventions. The HPRS intervention was defined as the presentation of three or four high probability requests prior to the presentation of a low probability request (Mace et al., 1988).

Research design. Studies utilizing an experimental group, quasi-experimental, or single-case design (SCD) to investigate the efficacy of HPRS were included in this review. SCD studies accepted for this review were withdrawal of treatment, multiple baseline, multiple probe, alternating treatment, and changing criterion designs (Kratochwill et al., 2013; Wong et al., 2014).

Search Procedures

Screening of articles identified by Wong et al. (2014). Nine articles identified as having met criteria for qualification as an EBP in the Wong et al. (2014) review were screened to determine inclusion. Article titles and abstracts were screened to determine if the procedures used in the behavioral momentum interventions utilized a HPRS based on the definition provided by Mace et al. (1988). One article was identified as not utilizing a
HPRS (Ducharme et al., 1994) and was excluded from this review, leaving a total of eight articles from Wong et al.

Expanded literature search. A literature search was conducted using electronic print sources using a university’s electronic library database (e.g., ERIC, Education Research Complete, Academic Search Complete, ArticleFirst, WorldCat.org, ScienceDirect, PsycARTICLES, PsycINFO, Social Work Abstracts) and Google Scholar. To expand and evaluate HPRS as an EBP, a search of the literature using key words associated with a diagnosis of autism (i.e., autism, autism spectrum disorder, ASD) and HPRS (i.e., high-probability request sequence, high-p request sequence, high-p low-p requests, behavior momentum interventions, behavioral momentum, interspersed requests, pre-task requests, high probability instructional sequence, high probability sequence) was conducted to include studies published in peer reviewed journals between 2012 and 2016. Twenty-three articles were identified as being potentially eligible for inclusion in this review. Article titles and abstracts were screened to determine (a) experimental methodology, (b) target population, and (c) use of HPRS. After screening, 14 articles were excluded based on title and three articles were excluded based on abstract review, resulting in six articles published between 2012 and 2016 that were included in the final review. Combined with the eight articles identified by Wong et al. (2014), 14 total articles were included in this review. Agreement for inclusion and exclusion of articles was 100%.

Review of Literature

Coding for quality indicators. Two doctoral students in special education served as reviewers. Reviewers used the single-case design EBP inclusion criteria checklist developed by Wong et al. (2014) based on the work of Horner et al. (2005), Nathan and Gorman (2007), Rogers and Vismara (2008), and the earlier work by APA Division 12 (Chambless & Hollon, 1998) to code articles. The EBP criteria checklist included information about (a) the dependent variable, (b) research questions, (c) measurement system, (d) interobserver agreement (IOA), (e) clear description of procedures utilized in baseline and intervention, (f) repeated measures shown in a graphical format, and (g) at least three different replications across time or phases. If a study met all quality indicators listed on the EBP checklist, the study was included as evidence supporting HPRS as an EBP.

Interrater reliability on quality indicators. Interrater reliability was calculated using an item-by-item analysis of the quality indicator checklist. Interrater agreement was collected for 100% of the articles across reviewers. The formula for inter-rater agreement was total agreements divided by agreements plus disagreements multiplied by 100. Two levels of agreement were calculated to include agreement on individual items of the criteria checklist and the agreement on the summative evaluation of whether the study met or did not meet criteria for inclusion. Mean inter-rater agreement for both levels was 100%.

Results

Fourteen studies published in peer-reviewed journals between 1992 and 2016 were identified and coded using a quality indicator checklist. Table 1 summarizes descriptive information about each study included in the review.

Descriptive Analysis of Literature Reviewed

Table 1 provides a summary of the description information for the 14 studies included in this review. Twenty-six participants diagnosed with ASD were included in the studies reviewed. Participants ranged from 3 to 15 years old. The 14 studies reviewed used SCD. Specifically, five studies used a multiple baseline design (Davis et al., 1992, 1994; Esch & Fryling, 2013; Jung et al., 2008; Meier, Fryling, & Wallace, 2012), five studies used a withdrawal of treatment design (Banda & Kubina, 2006; Ewry & Fryling, 2016; Patel et al., 2007; Pitts & Dymond, 2012; Romano & Roll, 2000), three studies used an alternating treatments design (Houlihan et al., 1994; Penrod, Gardella, & Fernand, 2012; Riviere et al., 2011), and one study used a multiple probe design (Kelly & Holloway, 2015). Thirteen studies reviewed reported behavioral (i.e., compliance, social interactions, food acceptance) outcomes. One
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<td>Davis, Brady, Williams, &amp; Hamilton (1992)</td>
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<td>Davis, Brady, Hamilton, McEvoy, &amp; Williams (1994)</td>
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<td>Tact fluency</td>
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study reported educational (tact fluency) outcomes.

Quality of Literature

A total of 14 studies met the inclusion criteria for HPRS as an EBP for individuals with ASD. After coding for quality indicators using the inclusion criteria checklist, all 14 studies (100%) were identified as having met the criteria to support HPRS as an EBP. Table 2 highlights the eight studies identified by Wong et al. (2014) included in the review and the EBP inclusion criteria checklist. Table 3 indicates the additional six studies identified in the expanded search to include literature published in peer review journals between 2012 and 2016 and the EBP inclusion criteria checklist. Of the literature reviewed, each study had (a) a dependent variable aligned with the research question or purpose of the study, (b) a clearly defined dependent variable, (c) a measurement system aligned with the dependent variable that produced a quantifiable index, (d) a second observer collect data on the dependent variable for at least 20% of sessions across conditions, (e) interobserver agreement of 80% or higher, (f) a clearly described independent variable, (f) a clearly described baseline, (g) results displayed in a graphical format showing repeated measures across time, and (h) results demonstrating change in the dependent variable when the independent variable is manipulated by the experimenter at three different points in time or across three phase repetitions.

HPRS as an EBP

To classify HPRS interventions as an EBP for individuals with ASD, at least five quality SCD studies conducted by three different research groups and involving a total of 20 or more participants across studies must be supported (Wong et al., 2014). After coding for quality indicators and analyzing data, 14 studies investigating HPRS for individuals with ASD were conducted by 12 different research groups. The 14 studies included 26 participants diagnosed with ASD. The findings of this literature review suggest that HPRS can be considered as an EBP for individuals diagnosed with ASD.

Discussion

The purpose of this comprehensive literature review was to expand the findings of Wong et. al. (2014) to evaluate the literature on HPRS published from 2012–2016 using the evidence-based criteria developed by Wong et. al. (2014) and to determine if HPRS can be considered an EBP for individuals with ASD. Results of the expanded EBP review add to the findings of Wong et al. (2014) by identifying HPRS as an EBP for individuals with ASD. Based on literature published in peer-reviewed journals between 2012–2016, six additional studies were found to add to existing literature to the Wong et al. findings supporting the effectiveness of HPRS interventions for individuals with ASD. Present results indicated an additional 11 participants were included from a total of six, high-quality single-case design studies conducted by four different groups. When combined with the work of Wong et al. (2014), HPRS interventions now have a total of 26 participants, across 14 high-quality single-case design studies conducted by 12 different investigators or research groups. Based on the criteria set by Wong et al. (i.e., at least five high quality single case design studies, conducted by at least three different researchers or researcher groups, and having a total of at least 20 participants across studies), HPRS can be considered an EBP for students with ASD. Together, these findings indicate HPRS are effective when implemented with students with ASD across academic, behavioral, and developmental domains (e.g., acceptance of low-p foods, fluency of low-p tacts, low-p compliance, academic, non-academic), settings (e.g., classroom, home, doctor’s office), and participants (e.g., ages 3 to 20).

Limitations

As evident in the literature review process, a diverse use of terminology (e.g., behavioral momentum interventions, high-probability instructional sequence, high-probability request sequence, interspersed requests) used to represent the focused intervention practice (i.e., HPRS) complicated the process of identifying and coding peer-reviewed studies. It is possible that other studies could have been in-
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<td>Does the dependent variable align with the research question or purpose of the study?</td>
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<td>Was the dependent variable clearly defined such that another person could identify an occurrence or non-occurrence of the response?</td>
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<td>Did a secondary observer collect data on the dependent variable for at least 20% of sessions across conditions?</td>
<td>Y</td>
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<tr>
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<tr>
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<td>Y</td>
<td>Y</td>
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<td>Y</td>
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<td>Y</td>
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</tr>
<tr>
<td>Are the results displayed in a graphical format showing repeated measures for a single case (e.g., behavior, participant, group) across time?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Do the results demonstrate changes in the dependent variable when the independent variable is manipulated by the experimenter at three different points in time or across three phase repetitions? *Alternating treatment designs require at least 4 repetitions of the alternating sequence.</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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</table>

**Number of Participants**

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<tr>
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<td>Y</td>
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<td>Y</td>
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<td>Was the dependent variable clearly defined such that another person could identify an occurrence or non-occurrence of the response?</td>
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<td>Y</td>
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<tr>
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<td>Y</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Was mean interobserver agreement (IOA) 80% or greater OR kappa of .60 or greater?</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Is the independent variable described with enough information to allow for a clear understanding about the critical differences between baseline and intervention conditions, or were references to other material used if description does not allow for a clear understanding?</td>
<td>Y</td>
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<td>Y</td>
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<td>Y</td>
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<td>Was the baseline described in a manner that allows for a clear understanding of the differences between the baseline and intervention conditions?</td>
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<td>Y</td>
<td>Y</td>
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<tr>
<td>Are the results displayed in a graphical format showing repeated measures for a single case (e.g., behavior, participant, group) across time?</td>
<td>Y</td>
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<td>Y</td>
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<tr>
<td>Do the results demonstrate changes in the dependent variable when the independent variable is manipulated by the experimenter at three different points in time or across three phase repetitions? *Alternating treatment designs require at least 4 repetitions of the alternating sequence.</td>
<td>Y</td>
<td>Y</td>
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</tr>
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</table>
cluded in the review, but variation in terminology made it difficult to identify relevant studies. Furthermore, studies included in the review varied in procedural detail such as (a) the time between high-p and low-p requests, (b) the frequency and time of reinforcement given after complying with low-p requests, and (c) the use of peer modeling. These additional variables should be taken into consideration when evaluating the level of evidence that supports this practice.

**Suggestions for Future Research**

Additional research should investigate the effectiveness of HPRS used in treatment packages (e.g., HPRS with low-p demand fading, Penrod et al., 2012; HPRS with and without programmed reinforcement, Wilder, Majdalany, Sturkie, & Smeltz, 2015). Further, it is important to investigate the effects of this focused treatment practice across participant ages, skill levels, and activities (e.g., academic instruction). In addition, future research should evaluate the intervention’s effects on participants’ maintenance and generalization of target behaviors. The majority of the articles in this review demonstrated that adults (i.e., parents, teachers, therapists) in various settings could implement a HPRS with fidelity. Few studies (i.e., Davis et al., 1994; Jung et al., 2008) attempted to use peers as the primary interventionist. Future research should investigate the use of peers without disabilities to increase social interactions. In addition to the use of various adults, studies included in this review also varied on what met criteria to be considered high-probability behaviors. Only one study was found that investigated using medium-probability behaviors in their intervention package (i.e., Romano & Roll, 2000). Romano and Roll suggested that a larger pool of requests could be used by broadening the definition of the types of requests (i.e., high-p and medium-p) that could be implemented prior to low-p requests. Future research should continue to investigate medium-probability requests as a means to increase compliance to low-probability behaviors.

**Implications for Practice**

When HPRS is used as an antecedent-based intervention, it can be easy to implement (Meier et al., 2012), used to increase skill acquisition, and prevent problem behavior. With an increased emphasis on the use of EBP across educational and therapeutic settings, additional training and support should be given to educators and practitioners to increase awareness of this strategy. As an EBP for individuals diagnosed with ASD, HPRS could be used to increase skill acquisition and compliance across various settings. This intervention package requires limited training, no materials, and is cost effective.

**References**


Word Study Intervention for Students with ASD: A Multiple Baseline Study of Data-Based Individualization

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Brescia University College

Marie Black, Alexandra Miller, William J. Therrien, and Marcia Invernizzi  
University of Virginia

Abstract: This multiple baseline across participants study examined the efficacy of a data-based individualization word study intervention for students with autism spectrum disorder (N = 5) and low word reading skills. An experienced interventionist provided 1:1 word reading instruction in 30-minute sessions five times per week for an average of 10 sessions per participant. Intervention effects for directly taught words and words with similar spelling patterns were estimated using visual analysis and calculation of mean differences across baseline and intervention phases. Results indicate immediate and consistent improvements in word reading outcomes across all participants.

Recent reports suggest that as many as one in three students with autism spectrum disorder (ASD) have reader profiles of low decoding skills and comprehension (Nation, Clarke, Wright, & Williams, 2006; Wei, Christiano, Yu, Wagner & Spiker, 2014). Nation et al. (2006) reported 42% of students with ASD in their sample as having low decoding skills in addition to low reading comprehension. More recently, Wei et al. (2014) reported a similar finding of 32% of students with ASD having low decoding. Despite this being the case, reading interventions for students with ASD over the last 10 years have primarily focused on reading comprehension. The overwhelming focus on comprehension instruction is not surprising considering the influential reader profile studies conducted over several decades which described average or above average decoding skills with low comprehension for students with ASD (Frith & Snowling, 1983; Goldberg, 1987; Minshew, Goldstein, Taylor, & Siegel, 1994; O’Connor & Hermelin, 1994; Pattie & Lupinetti, 1993). While there does appear to be agreement among many researchers on the pervasive difficulties students with ASD experience with reading comprehension (Fluery et al., 2014), it is also important to note the needs of students with ASD that do not fit this typical profile. Beyond comprehension needs, it is also important to investigate other challenges faced by students with ASD with less typical reader profiles such as those who face challenges with decoding and word reading.

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Code-Based Reading Intervention Research for Students with Autism Spectrum Disorders

Whalon and colleagues (2009) conducted a synthesis of reading interventions for students with ASD that identified eleven studies providing instruction in decoding, fluency, vocabulary, and comprehension. Of these 11 studies, only three pre/posttest design and one single-case design study investigated code-based in-
tventions (Basil & Reyes, 2003; Coleman-Martin, Heller, Chihak, & Irvine, 2005; Heimann, Nelson, Tjus, & Gilberg, 1995; Tjus, Heimann, & Nelson, 1998). Three of the studies used modified versions of the same computer assisted instructional software program (Basil & Reyes, 2003; Heimann et al., 1995; Tjus et al., 1998). The software program provides opportunities for students to select words and word groups to form sentences with tasks over time requiring increasingly more complex grammatical structures. Across these studies, the findings showed some promise yet were inconclusive due to a number of methodological issues including small sample sizes with large age ranges, unclear screening procedures, and lack of comparison or control conditions.

Basil and Reyes (2003) investigated the software program along with a scaffolding approach in a pre/posttest design. Two students with ASD, ages 8 and 14, received 12 hours of instruction in 30 min. sessions twice per week. While both students “mastered” the lessons according to the software-based proximal measure, only one student made significant gains from pre to post-test on measures of phonological awareness (PA) and word spelling. Heimann et al. (1995) investigated the software program with a larger sample size of students with ASD ($N = 110$) ranging in age from 6 to 14 years old. Significant gains in reading were reported, however, no significant gains were detected on PA measures. Tjus et al. (1998) also reported mixed results for students with ASD with significant gains on PA and reading measures reported on initial post-tests but no significance differences found on delayed post-test measures.

Utilizing a multiple condition design with drop-down baselines, Coleman-Martin et al. (2005) investigated a computer-assisted instructional (CAI) approach using a nonverbal reading approach for word identification for one student with a dual diagnosis of ASD and moderate intellectual disability. Researchers compared baseline phases to teacher only, teacher plus CAI, and CAI only. The student, ‘Carrie’, had low mean scores on percent of words identified correctly ($M = 13.3\%$) during baseline. The remaining baseline phases stayed consistently low ($M = 0.0\%$). Across the three treatment conditions the teacher only phase had the steepest slope with a clear upward trend ending with Carrie scoring 80% correct on three of her last four scores. Initially during the teacher plus CAI condition the scores dropped to 60% correct. However, at the end of this phase Carrie scored 100% correct on her last two scores. During the CAI only phase, scores ranged from 60% to 80% correct with the exception of a few outliers.

Following the synthesis by Whallon et al. (2009) some additional studies were conducted that investigated word study interventions for students with ASD. Infantino and Hempenstall (2006) investigated a direct instruction intervention of word reading that used standardized protocols for the basis of instruction (Infantino & Hempenstall, 2006). After 23 hours of instruction, one student with ASD did not show significant gains in decoding skills with no differences in percentile rank, age and grade equivalents. In a multiple baseline across probes design, Whitcomb, Bass, and Luiselli (2011) reported improved accuracy with word lists after one student with ASD participated in five intervention sessions provided through computer assisted instruction. Similarly, in a multiple baseline across probes study, Yaw et al. (2011) reported an immediate increase in sight word reading across 16 intervention sessions delivered to one grade 6 student through computer assisted instruction.

Rationale and Hypotheses

Initial data on reading performance for this study were taken from a larger observation study investigating issues of reading instruction for students with ASD (Solis, Black, Romig, & Miller, in development). The district personnel informed us of their concern with students’ word reading skills rather than reading comprehension, which were further confirmed from our testing results. We then worked with district personnel to design a study that would integrate in with their current efforts to address the problem rather than supplant any attempts at intervention. Utilizing the techniques described by the National Center on Intensive Interventions (2013), we adapted the word study reading program that was in use by the school district, Words Their Way (Bear, Invernizzi, Templeton,
& Johnston, 2016), by infusing explicit instruction and corrective feedback through a data-based individualization (DBI) approach to intervention. The Words Their Way DBI (WW-DBI) approach was designed to address the most intense instructional needs for students who have not responded to previous interventions (National Center on Intensive Interventions, 2013).

The purpose of this study was to determine if adaptations of the district adopted word study curricula would increase performance word study skills for words directly taught and for words that followed the same spelling patterns. The study addressed the following research hypotheses: The WW-DBI intervention will result in improved performance on words directly compared to baseline performance. The WW-DBI intervention will result in improved performance on words not taught but that followed the same word patterns as those taught compared to baseline performance.

Method

Setting and Instructor

All participants were from one rural school located in a southeastern state. According to data from the State Department of Education, the racial and ethnic population of students in the district at the time of the study included the following: Caucasian, 73.9%; African American, 13.0%; Hispanic, 6.90%; two or more races, 5.0%; Asian, 0.50%; Native American, 0.30%. All intervention sessions were conducted in a small room adjacent to the school library. No other students were present during the intervention. Sessions were held during students’ intervention or resource period and scheduled for 30 minutes per day, five days per week.

The instructor was a retired special educator who previously worked at the school district for 30 years. She had extensive background in teaching reading to children with disabilities. She was hired, trained, and supervised by the research team.

Participants

Students. Four male students and one female student with ASD (as identified by the school district through the multi-disciplinary team process) in grades 5–7 participated in the study (N = 5). All students were Caucasian. According to school district personnel, students all received a combination of general education and special education classes with minimal behavior supports provided as needed. Parent consent and student assent were acquired for all participants as approved by the Institutional Review Board from the university of the first author. As part of the screening procedure, participants were administered two standardized reading measures: the Test of Sentence Reading Comprehension (TOSREC) (Wagner, Torgesen, Rashotte, & Pearson, 2010) and the Test of Word Reading Efficiency (TOWRE) (Torgesen, Wagner, & Rashotte, 1999). The Kaufmann Brief Intelligence Test Verbal (KBIT-2) (Kaufman & Kaufman, 2004) was also administered to provide descriptive data. To qualify for the study, students needed to meet the following criteria: TOSREC standard score ≥ 85, TOWRE standard score ≥ 80.

To determine the appropriate starting point for intervention, each student was administered the spelling inventory placement test from Words Their Way to identify their current word part knowledge. See Table 1 for a summary of participant information including age and grade placement.

Materials

Individualized pool of unknown words. We adapted the procedures described by Ferkis, Belfiore, and Skinner (1997) to guide the development of the word lists. Using words selected from Words Their Way (Bear et al., 2016), we developed a pretest probe to determine unknown words for each participant. Prior to administration of the pretest, the words were leveled for frequency using the Corpus of Contemporary American English (COCA; http://corpus.byu.edu/coca/) with high frequency words being removed. These unknown words, in turn, were used to develop the word banks included in the baseline probes, intervention materials, and intervention probes of taught words. The initial word probe was delivered on an iPad using standard-sized PowerPoint slides. Each slide contained 10 words from a single developmental level of the Words Their Way scope and sequence (Bear et al., 2016). Each student’s
level was determined by the *Words Their Way* spelling inventory placement test (Bear et al., 2016) (see Table 1), and each student’s scope and sequence was individualized accordingly.

**Scope and sequence development.** In order to develop each student’s individualized scope and sequence, we compiled and sorted all unknown words by spelling feature. Using the principles of word study and minimally discriminant pairs, we developed weekly word sorts that followed the developmental spelling sequence established in *Words Their Way* (Bear et al., 2016). Each sort contained 15 words, 10 words established through the pre-assessment as unknown to the student, and a set of five generalization words following the same spelling pattern. This scope and sequence was used to develop the lessons, baseline and intervention probes, and curriculum-based measures.

**Dependent measures.** Based on the individualized pool of unknown words, daily 20-word probes were administered during the baseline phase. During the intervention phase, each probe contained 10 words that were directly taught as a part of the word sort, five words that were not included in the word sort but followed the same spelling patterns as those in the sorting activity, and five distractor words.

### Table 1

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age (years)</th>
<th>Grade</th>
<th>KBIT Verbal*</th>
<th>TOSREC*</th>
<th>TOWRE*</th>
<th>WWSI</th>
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<td>11</td>
<td>6</td>
<td>79</td>
<td>68</td>
<td>77</td>
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</tr>
<tr>
<td>Tony</td>
<td>13</td>
<td>7</td>
<td>78</td>
<td>76</td>
<td>76</td>
<td>Early within word</td>
</tr>
<tr>
<td>Richard</td>
<td>13</td>
<td>6</td>
<td>87</td>
<td>85</td>
<td>63</td>
<td>Late within word</td>
</tr>
<tr>
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<td>12</td>
<td>6</td>
<td>66</td>
<td>61</td>
<td>54</td>
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<tr>
<td>Justin</td>
<td>10</td>
<td>5</td>
<td>80</td>
<td>64</td>
<td>77</td>
<td>Early within word</td>
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</tbody>
</table>

*Note:* * = Reported as standard scores; KBIT = Kaufman Brief Intelligence Test; TOSREC = Test of Sentence Reading Efficiency and Comprehension; TOWRE = Test of Word Reading Efficiency; WWSI = Words Their Way Spelling Inventory placement information.

Average alternate-form coefficients range from 0.84 to 0.95.

*The Test of Word Reading Efficiency (TOWRE; Torgesen et al. 1999).* The TOWRE consists of two individually administered 45-second sub-tests of sight word reading and phonemic decoding efficiency. Each list of words and non-words starts with the least-difficult items and gradually increases in difficulty. The alternate-forms reliability coefficients were reported as 0.91 to 0.97 (Torgesen et al., 1999).

*Kaufman Brief Intelligence Test–Second Edition (KBIT-2; Kaufman & Kaufman, 2004).* The KBIT-2 is individually administered in approximately 15 min; it assesses both verbal and nonverbal ability in people from 4 through 90 years of age. The KBIT-2 is composed of two separate scales. The Verbal Scale contains two kinds of items—Verbal Knowledge and Riddles—both of which assess crystallized ability (knowledge of words and their meanings). The items cover both receptive and expressive vocabulary, and they do not require reading or spelling. Composite internal consistency reliabilities were ranged from 0.89 to 0.96. Validity studies yielded moderate to high correlations with both construct and concurrent validity studies (Kaufman & Kaufman, 2004).

*Dependent measures.* Based on the individualized pool of unknown words, daily 20-word probes were administered during the baseline phase. During the intervention phase, each probe contained 10 words that were directly taught as a part of the word sort, five words that were not included in the word sort but followed the same spelling patterns as those in the sorting activity, and five distractor words.
used to control for cueing during the probes. The daily probes contained two dependent measures. The first measure was students’ identification of the 10 explicitly taught words. These words served as a measure of students’ acquisition of directly taught words. The second measure consisted of five words not directly taught. These words served as a measure of students’ ability to generalize taught spelling patterns to novel, unknown words.

Probes were delivered using a single word list each day. Directly taught words remained the same for the 5-day instructional cycle, generalization words varied across days of the week. When recording word reading accuracy, the tutor allowed 5 seconds per word for a student response and allowed for unprompted, self-corrections within those 5 seconds. One point was awarded for each correctly pronounced word. See Figure 1 for an annotated example of a daily probe.

Procedure

**Tutor training.** We trained one tutor, a retired special educator with up-to-date teacher certification, in two 2-hour sessions. The first day of training consisted of reviewing the principles of word study (Bear et al., 2016), the principles of explicit instruction (Archer & Hughes, 2011), and error correction procedures established by the first author of the study. The second day of training consisted of detailing the specific instructional routine and materials and having the tutor conduct mock sessions of the intervention until she demonstrated mastery of the instructional sequence. Throughout the training, the tutor was encouraged to balance following the instructional routines along with maintaining some instructional flexibility which is a core feature built into *Words Their Way* (Bear et al., 2016).

**Intervention.** The word study intervention WW-DBI consisted of daily teacher-directed word sorts and guided practice in word feature analysis. The intervention was an adapted version of the word study instructional routine detailed by Bear et al. (2016). To better align to the needs of students with ASD, we made the following modifications: instruction was provided one to one instead of in groups, increased teacher modeling and guided feedback (Archer & Hughes, 2011) during exploration, additional instructor prompts and scaffolds during guided practice, and increased intervention duration. The tutor used the current behavior management system of positive reinforcement as outlined on each student’s individualized education plan.

Students met individually with the tutor for five days per week for 15- to 20-minutes of instruction (30 min with probe administration). Words used in each sort were 50% known and/or high frequency words and 50% unknown to the student. During instruction, the following 7-step process was followed.

![Daily Probe – Annotated Example](image-url)
The instructor delivered a goal statement for the lesson, and after session one, a review was provided on the previous day’s word sort. The tutor reviewed the new sort by establishing word categories and reviewing the words’ pronunciations and meanings. The tutor demonstrated how to sort the words by sound and repeated the process for sorting by sight or spelling patterns. Using a teacher-directed, closed sort, the tutor guided the student through the process of sorting the words under the given headers, working through the words one at a time. Using the sentence frames provided as a meta-cognitive guide, the instructor introduced each word and prompted discussion about the words regarding position of spelling features within the word, frequency, and related words. The tutor gradually released this responsibility to the students, providing praise and corrective feedback. The students led the sort (independent practice) while the tutor prompted the student to say the words and compare them as they sorted. Following completion of the sort, the tutor guided the students through a reflection process. During the reflection process, the tutor prompted the student to compare and contrast the words and their features. Sentence frames such as “I notice that...” and “When I read these words, I hear...” were used to promote students’ use of feature analysis. To encourage students to think about their rationale for sorting words and making connections to the words’ sounds, spellings, and meanings, the tutor asked the student to explain why they sorted the words as they had. This explanation of students’ thinking was recorded on a flip chart to be used during the following day’s lesson.

Procedural Integrity and Reliability

All intervention and assessment sessions were audio-recorded. We used these recordings to check a random sample of 20% of the intervention sessions for procedural integrity and reliability. From the audio recordings, a researcher familiar with the intervention used an implementation validity checklist of the core instructional steps of the intervention to determine the percent of expected instructional steps. See Figure 2 for an example of treatment integrity protocol. The integrity
and reliability of implementation was 82% for the coded sessions.

Reliability of assessment data was assessed for 28% of the sessions by rescoring the sessions’ dependent measures and comparing the scores obtained to the scores reported by the tutor. A total of 35 sessions were dual coded by two raters. Interobserver agreement was then determined by calculating the total number of agreements divided by the total number of agreements and disagreements multiplied by 100. The mean agreement across observers was 96.1%.

Experimental Design and Data Analysis
A single-case multiple baseline design across participants was used to evaluate the effects of the intervention on participants’ abilities to read words in isolation. The advantage of a multiple baseline design, unlike a reversal design, is it allows for the empirical examination of dependent measures (i.e., word reading) that do not reverse upon removal of the intervention (Tawney & Gast, 1984). Furthermore, the sequential implementation of the independent variable parallels the practices of teachers and generalization of the behavior change is monitored through the design (Gast, Lloyd, & Ledford, 2014).

Researchers have traditionally used the visual analysis method to interpret single case study results (Kratochwill et al., 2010). Currently, there is not consensus regarding one statistical analysis procedure to interpret results from single-case design studies (Kratochwill et al., 2010). For these reasons, we analyzed data based on visual inspection of the graph for each participant. Visual inspection of the graphs was based on the (a) level, (b) trend, (c) variability, (d) overlap, (e) immedacy of the effect, and (f) consistency of data patterns across similar phases (Kratochwill et al., 2010).

Results

Edward
Edward’s word reading data are presented in Figure 3. During baseline, Edward’s scores on daily reading probes ranged from 20% to 60% with a mean of 45%. Upon implementation of WW-DBI intervention, Edward’s level of taught and untaught word reading accuracy increased to means of 86% and 68% respectively. Scores for taught words ranged from 60% to 100%, and scores for untaught words ranged from 0% to 100% (See Table 2). Upon introduction of the intervention, an immediate increase in Edward’s score is observed for taught words and a gradual increase is observed for untaught words. Visual inspection of the graph reveals an upward trend for both taught and untaught words during the intervention phase. Calculation of overlapping data between intervention and baseline phases shows 5% overlap for taught words and 58% overlap for untaught words.

Tony
Tony’s word reading data are presented in Figure 3. Tony’s scores on daily reading probes ranged from 20% to 50% during baseline phase, with a mean of 38%. Upon implementation of WW-DBI intervention, Tony’s level of taught and untaught word reading accuracy increased to means of 98% and 71% respectively. Scores for taught words ranged from 90% to 100%, and scores for untaught words ranged from 40% to 100% (See Table 2). Upon introduction of the intervention, an immediate increase in Tony’s score is observed for both taught and untaught words. Visual inspection of the graph reveals an upward trend for both taught and untaught words during the intervention phase. Calculation of overlapping data between intervention and baseline phases shows 0% overlap for taught words and 8% overlap for untaught words.

Richard
Richard’s word reading data are presented in Figure 3. During baseline, Richard’s scores on daily reading probes ranged from 15% to 55% with a mean of 29%. Upon implementation of WW-DBI intervention, Richard’s level of taught and untaught word reading accuracy increased to means of 95% and 74% respectively. Scores for taught words ranged from 70% to 100%, and scores for untaught words ranged from 40% to 100% (See Table 2). Similar to Edward’s results, upon introduction
of the intervention phase, an immediate increase in Richard’s score is observed for taught words and a gradual increase for untaught words. Visual inspection of the graph reveals an upward trend for both taught and untaught words during the intervention period.
phase. Calculation of overlapping data between intervention and baseline phases shows 0% overlap for taught words and 10% overlap for untaught words.

Julia

Julia’s word reading data are presented in Figure 3. During baseline, Julia’s scores on daily reading probes ranged from 5% to 60% with a mean of 31%. Upon implementation of WW-DBI intervention, Julia’s level of taught word reading accuracy increased to a mean of 70%, and her untaught word reading accuracy increased to a mean of 37%. Scores for taught words ranged from 40% to 90%, and scores for untaught words ranged from 20% to 60%. Upon introduction of the intervention, a gradual increase and drop in Julia’s score is observed for both taught and untaught words. Visual inspection of the graph reveals a neutral trend for both taught and untaught words. Calculation of overlapping data between intervention and baseline phases shows 43% overlap for taught words and 100% overlap for untaught words.

Justin

Justin’s word reading data are presented in Figure 3. During baseline, Justin’s scores on daily reading probes ranged from 25% to 80% with a mean of 58%. Upon implementation of WW-DBI intervention, Justin’s level of taught and untaught word reading accuracy increased to means of 87% and 93% respectively. Scores for taught and untaught words ranged from 80% to 100%. Upon introduction of the intervention, a gradual increase in Justin’s score is observed for taught and untaught words. Visual inspection of the graph reveals a neutral trend for taught words and an upward trend for untaught words. Calculation of overlapping data between intervention and baseline phases shows 67% overlap for taught words and 33% overlap for untaught words.

Discussion

The purpose of this study was to examine the impact of an adapted version of a widely used word study program on the word reading skills of students with ASD. Our aim was to examine the effectiveness of the intervention of words directly taught and words not directly taught that followed the same spelling patterns when implemented by a tutor hired, trained, and supervised by researchers. We hypothesized that with adaptations to the program, this approach is likely to improve performance for students with a history of very low performance with word reading (TOWRE, standard score $M = 69.4$).

Effectiveness of Intervention

Results indicate that the WW-DBI intervention was generally effective for improving performance with words directly taught and moderately effective with untaught words for students with ASD with low word reading skills. These gains in word reading skills are similar to findings reported in previous work (Coleman-Martin et al., 2005; Infantino & Hemenstall, 2006; Whitcomb et al., 2011; Yaw et al., 2011). During the baseline condition, students on average read 45.8% words correctly. During the intervention condition, students read an average of 87.2% words directly taught correct and an average of 68.6% of words not directly taught. All five participants had mean scores of words taught well above their baseline performance, and four of the five participants had mean scores of words not directly taught above their baseline performance.

There was a clear immediacy effect from baseline to intervention across all five participants. The average baseline score just prior to

<table>
<thead>
<tr>
<th>Participant</th>
<th>Baseline (%)</th>
<th>Taught (%)</th>
<th>Not Taught (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edward</td>
<td>45</td>
<td>86</td>
<td>68</td>
</tr>
<tr>
<td>Tony</td>
<td>38</td>
<td>98</td>
<td>71</td>
</tr>
<tr>
<td>Richard</td>
<td>29</td>
<td>95</td>
<td>74</td>
</tr>
<tr>
<td>Julia</td>
<td>31</td>
<td>70</td>
<td>37</td>
</tr>
<tr>
<td>Justin</td>
<td>58</td>
<td>87</td>
<td>93</td>
</tr>
</tbody>
</table>

Note: Scores represent percentage of words read correctly during the daily reading probes.
beginning intervention was 36% for words taught with the average score of words taught when starting intervention was 78%. The data indicate clear intervention effect at five points in time across baseline and intervention with each phase having three or more data points. In fact, the data “meets standards” as outlined by Kratochwill et al. (2010) for demonstrating an effect by having four phases with at least five data points per phase. Across four of the five participants the variability was relatively low for words directly taught with more variability with words not directly taught. It should also be noted that findings from the screening measures indicated much lower performance for the one participant that did not perform similarly to the others. Across both dependent measures, there was a neutral trend during the intervention phase of higher performance compared to baseline for four of the five participants. These findings suggest that when difficult words are targeted and explicitly taught to students, their performance in completing the task almost doubles. Even more compelling is evidence that the particular skill being instructed did in general transfer to words not directly taught. In other words, the adaptations to the word study program used by the school district appear to have improved performance for all participants.

We expected the procedural integrity to be above 90% during the sessions. The lower score of 82% still indicates that overall the instructional routines were followed the majority of the time. The lower score may be reflective of the flexibility that was emphasized during the training. Because of the heterogeneity and behavioral issues that are often typical of students with ASD, we wanted to make sure that the tutor felt empowered with a certain level of flexibility to address the uniqueness of each student.

**Limitations and Implications for Research**

There are several limitations to be considered when interpreting the results of this study. First, the tutor was very experienced with both the word study program that was adapted and with working students with ASD. The rapport between the students and the tutor may have resulted in higher outcomes and may also explain why little to no behavior management issues were reported. Future studies should consider use of school-based personnel including paraprofessionals that would likely be utilized for providing one to one interventions. Second, the length of the intervention was short considering the severity of students’ word reading difficulties. To overcome standard scores that are on average 2.0 SD below the normative sample on the TOWRE, students would most likely need intensive interventions of 80 sessions or more (Wanzek et al., 2013). An intervention with longer duration should also consider adding more distal outcomes measures such as weekly probes and pre/posttest standardized measures. Third, due to time constraints, we were unable to systematically capture social validity data from the students’ perspective. While the tutor did report that students appeared to enthusiastically participate, not having a social validity measure limits the external validity of the study. Finally, while we did not have access to assessment data defining the samples with respect to executive functioning variables (e.g., self-regulation, attention, memory), future researchers may want to consider how customizing interventions for students with ASD to align with their basic reading processes or executive functioning needs might influence students word reading outcomes.

**Implications for Educational Practice**

This study provides evidence for the value of adapting previously developed programs in order to increase the intervention’s intensity via smaller group size, lengthening intervention sessions, and developing an individualized instructional scope and sequence based on detailed assessment of previous performance. School personnel should consider these adaptations as an alternative to the use of separate programs that may incidentally cause confusion because of differences in instructional approach and the sequence of skills taught. With systematic and explicit instruction, students with ASD with low word reading skills in the upper grades can improve their word reading ability. Practitioners should keep in mind the intensity necessary to fully remediate word reading deficits and should consider providing more intensive interventions.
References


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Comparing Different Delivery Modes for Literacy-Based Behavioral Interventions during Employment Training for College Students with Developmental Disabilities

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Abstract: Recent research has shown the effectiveness of literacy-based behavioral interventions (LBBIs) as an instructional strategy for a host of skills and routines, including employment skills. This study compared the effects of three LBBI storybook formats (print, e-book, and e-book enhanced with video clips) on the accuracy and independent completion of new employment skills in college students with developmental disabilities. Comparisons of LBBI formats were made across office tasks including filing papers and reports, using an office copier, and answering a telephone and taking a message. All three LBBI formats were effective in increasing acquisition and maintenance of students' employment skills. When the formats were compared directly, the enhanced e-book was most effective, followed by the e-book and paper book delivery modes. However, this comparison differed somewhat across specific indicators used to establish differential effectiveness, suggesting that tasks and students also influence the effectiveness of the LBBI formats.

Individuals with developmental disabilities (DD) regularly experience difficulties learning and generalizing new skills, and these difficulties frequently result in a lack of meaningful, competitive employment opportunities (Kaye, Jans, & Jones, 2011). As a result, individuals with DD often require various forms of support to acquire skills needed for employment (Brady & Rosenberg, 2002; Carter, Austin, & Trainor, 2012). Typically these supports are needed to assure success in academic, employment, and community settings (Cihak, Kessler, & Alberto, 2008; Douglas, Ayres, & Langone, 2015; Van Laarhoven, Johnson, Van Laarhoven-Myers, Grider, & Grider, 2009).

For many people with developmental disabilities, employment supports are available only on a limited basis as a curricular option in secondary schools (Guy, Silington, Larsen, & Frank, 2009), or in post-secondary community settings that offer employment preparation experiences through human service agencies (e.g., Vocational Rehabilitation; Wehman, Chan, Ditchman, & Kang, 2014). Because opportunities for employment training has been limited, these interventions are often more intensive and require additional supports to be effective (Marshall et al., 2014), with interventions highly focused on providing coaching, feedback, and monitoring of individual work performance (Marshall et al., 2014; Wehman et al., 2014).

The advent of postsecondary education programs for adults with DD is a relatively new alternative as an employment training and education option. Adults with DD are increasingly able to attend college to further their education, improve their quality of life, and attain meaningful employment (Grigal, Hart, & Migliore, 2011; Stodden & Mruezek, 2010). These benefits, in turn, give students access to higher wages, health and monetary benefits, and higher job satisfaction (Test et al., 2009). In spite of these laudatory goals, there is a great deal of variability across most postsecondary education institutions in the structure and content of their programs (Grigal, Hart, & Weir, 2012), and a common standard for developing a robust technology.
of postsecondary training has yet to evolve (Gri- 

One strategy that has been used to teach em-
ployment skills in postsecondary education and
supported employment programs includes litera-
cy-based behavioral interventions (LBBIs). LBBI
is an umbrella term for a class of interventions
that uses print, visuals, and guided rehearsal in a
story format to teach new skills and routines
(Bucholz & Brady, 2008). Some examples of
LBBIs are Social Stories™ (Gray, 2000), social
scripts (Krantz & McClannahan, 1998), picture
activity schedule (Spriggs, Gast, & Ayres 2007),
and other interventions that provide opportuni-
ties for rehearsal following instruction with print
and pictures (Weiss & Harris, 2001). One recent
format for LBBIs involves a task analysis used to
create a story with instructions and pictures with
a personal point of view. This story forms the
medium used with an instructional package con-
sisting of a read, point, model, practice, and
praise format. This LBBI method has been suc-
cessful for teaching a variety of skills including
daily living (Brady, Hall, & Bielskus-Barone,
2016), safety (Kearney, Brady, Hall, & Hons-
berger, 2017), self-care (Brady, Honsberger, Ca-
dette, Honsberger, 2016), self-regulation (Hall,
Brady, & Morris, 2017), and job skills (Bucholz,
Brady, Duffy, Scott, & Kontosh, 2008).

LBBIs showed particular promise as a sup-
ported employment intervention in a pair of
experiments by Bucholz et al. (2008) where
investigators created LBBIs to teach employ-
ees to request additional work supplies. In the
first experiment, two women aged 26 and 48
with IQs ranging from 29 to “below 59” par-
ticipated in a work improvement plan as a
result of a long-term decline in their produc-
tivity. To increase their productivity, an LBBI
was created teaching them to request (a) as-
sistance, (b) more work supplies, and (c) a
break from work as appropriate. As a result of
the intervention, both women significantly in-
creased their requests and work productivity.
In addition, the co-workers closest to the em-
ployees also increased their productivity. In
observations conducted nearly three months
after the intervention was removed, these im-
provements were still evident. In the second
experiment, a 57-year-old man with Down syn-
drome received an LBBI to decrease transit-
tion time between breaks and work. The LBBI
targeted returning from breaks and decreas-
ing the levels of prompts needed by an escort.
Results showed a decrease in the need for
prompts by co-workers, and an increase in
independent and timely returns to work. In a
subsequent study with four adolescents with
moderate to severe autism (Brady, Honsberger
et al., 2016), an LBBI delivered by peers was
used to teach a food preparation skill. All four
students learned the task in 8–12 sessions and
showed maintenance of these skills on follow-
up probes delivered up to 30 days after the
removal of the intervention.

As the research with LBBIs has gained interest
as an intervention for secondary students and
adults, investigators have questioned whether
creating different story delivery formats and
implementing the intervention with technol-
ology might improve LBBI outcomes even fur-
ther (Brady, Hall et al., 2016; Kearney et al.,
2017). Traditionally, LBBIs have been deliv-
ered as paper-based written text, in short sto-
ries, or as scripts. However, implementing the
storybook strategy with electronic visual media
(such as portable electronic devices and tab-
lets) might make the interventions more ac-
cessible and appealing to students and adults
(Mechling, 2008), potentially increasing their
use during instruction in community employ-
ment settings. These alternate media formats
also have the ability to conjoin video model-
ing, auditory prompts, and written scripts. For
example, one form of video modeling breaks
a task into separate steps and video records
each task (Mechling, Ayers, Bryant, & Foster,
2014). If similar adaptations are applied to
LBBIs, it is possible that this class of inter-
ventions could expand its efficacy in ways that
parallel the expansion of video modeling or audio
and video prompting (Cihak et al., 2008; Doug-
las et al., 2015; Van Laarhoven et al., 2009). To
date, applications of technology have been
missing from the research on LBBIs.

Rationale for the Current Study

The purpose of the study was to compare three
different LBBI delivery modes for teaching em-
ployment skills to adults with developmental dis-
abilities. Specifically, we investigated the effec-
tiveness of an instructor delivered paper-based
book, an e-book, and an e-book enhanced
with video clips on the job skill acquisition of
college students in a postsecondary program.
for adults with developmental disabilities. Two research questions were posed:

1. Are there differences in job skill acquisition by adults with developmental disabilities based on the mode of delivery of a literacy-based behavioral intervention?

2. Are there differences in the maintenance of newly learned job skills based on the LBBI delivery mode?

Method

Participants

Three adults attending a postsecondary college program for people with developmental disabilities, all aged 22, participated in the study. All were in the first year of their program, and were enrolled in specialized academic courses with employment exploration experiences. All had reading comprehension levels at a fourth grade equivalence. None of the students had prior office work experience although one had previously worked for a grocery store, and a second previously worked in a warehouse preparing items for shipping. All students assented to participate, and their parents provided consent prior to initiating the study. Participant characteristics are summarized in Table 1.

Task and Setting

Three job skills were selected based on (a) students’ career interests, (b) their job coach’s recommendations, and (c) routines required in their employment settings. These skills included (a) filing papers and reports in folders and then placing them in filing cabinets, (b) copying papers using an office copier, and (c) answering an office telephone and taking a message. Prior to selecting each task, students demonstrated that they were physically capable of performing each task. Instruction for all three tasks took place on the university campus in the job coaching office. This is also where students performed the phone and filing tasks. For the copying task, students performed the task in a work room with an office copier located just down the hall from the job coaching office.

Behavioral Measure, Data Collection, and Inter-Observer Agreement

A task analysis for each of the three job skills was developed and served as the behavioral measure for each student. Each task analysis contained 10 to 11 steps and, in turn, was used to construct the LBBI story that formed the basis...
of instruction. Data were collected for each student individually by observing the student performing the skill, and then scoring each step in the task analysis as (a) correct and independent, (b) correct with prompts, or (c) incorrect.

A correct and independent step was defined if the student performed the step in the task analysis without assistance. Correct with prompts was recorded if the student referred back to the book to get information on how to complete a step, or required a direction to seek that information from the book. An incorrect response was recorded if students made errors that they were unable to correct themselves, if they did not complete a step in the task analysis, or if they omitted a step. Steps had to be performed in a strict sequential order only if required for the skill to be completed. For example, when making copies students could put the papers in the feeder first, or they could enter the password first; the order of these particular steps was irrelevant to performing the whole task. However, when making copies, students had to put the password into the copier before entering the desired number of copies. Only steps that were both correct and independent were used for instructional decisions and included in the graphed results.

Data were collected by observers stationed approximately five feet away from the students, yet close enough to see and hear them carry out the task. Observers were graduate students and experienced special education teachers. Observers were trained to criteria on the data collection system and practiced using the data sheets prior to the study. On 35% of the sessions two observers recorded the college students’ performance simultaneously for purposes of assessing inter-observer agreement. This accounted for 35% of the sessions for Karen, 38% of sessions for Marty, and 32% for Diane. Across the tasks, this accounted for 43% of the observations for the filing task, 42% of the observations for copying, and 31% of the observations for answering the phone. Agreement was determined by counting the steps of the task analysis scored the same by both observers, and dividing that number by the total number of steps observed, then multiplying by 100. Total agreement across all participants for all three task analyses was greater than 99%, with only one session not having 100% agreement. (Agreement on Diane’s filing was 91% for one session.)

Development of the LBBI Stories

After each of the job skills was task analyzed, a story was constructed depicting how to complete the steps successfully. For filing there were 10 steps in the task analysis, with nine pages plus a front cover; in this book two of the steps were combined on one page. The copying task analysis also had 10 steps and a 10-page story, plus a front cover (each step was given its own page in the copying book). The task analysis for answering the telephone was 11 steps, but the book was only 10 pages plus a front cover; two steps were combined on one page. All of the stories were created in PowerPoint and the accompanying visuals were presented from a personal point-of-view, using guidelines described by Schreibman, Whalen, and Stahmer (2000) and implemented in other LBBI research (Brady, Hall et al., 2016; Brady, Honsberger et al., 2016; Hall et al., 2017).

For the paper book and e-book the same PowerPoint presentation was used. The only difference between these two story formats was whether the book was presented in print format in a 3-ring binder, or on an i-Pad in the PowerPoint application. The accompanying visuals for the paper book and e-book were approximately 3x4 inches. For the enhanced e-book the same presentation was used but the pictures were replaced with a short video clip of the step, also presented from a personal point-of-view. The videos were approximately the same size as the pictures and lasted between two and 14 seconds, with the average video clip lasting approximately four seconds. Each page of the three book formats contained one to two sentences at the top of the page describing the step portrayed in the picture or video. Sentences contained between three and 16 words, with an average of eight words. A sample page from a story is found in Figure 1.

Experimental Procedures

Baseline. During baseline, an investigator in the job coach’s office asked individual students to “file this paper”, “make three copies”, and “answer the phone and take a message if it rings”. Each request was given independently
and students were given 30 seconds to complete each step of the task analysis. If students said they did not know what to do next, if they completed the task with errors, or if 30 seconds transpired without completing a step, the session was stopped. During all baseline sessions, the paper book, e-book, or enhanced e-book assigned to the student for the task was present, but no prompts were given to the student to use or not use the storybook to assist with the task.

Preparation for intervention. Prior to intervention, students were randomly assigned to a different LBBI presentation format for one of the three employment tasks. Following the assignment for the first presentation mode and task, the delivery formats for the remaining tasks were counterbalanced across the students so that each student was assigned each of the three formats across all three tasks. That is, the LBBI delivery mode differed for each student for the filing task, the copying task, and the telephone answering task. A summary of the delivery formats and employment tasks across the three students is found in Table 2.

Intervention. The LBBI was implemented independently for each student. Students were provided with the intervention for each task once per day, for 4 to 5 days each week. During the intervention, an investigator and student sat at a table in the job coaching office (the same office used during baseline) with the assigned book displayed in front of them. The student read each page of the story aloud, and an investigator instructed the student to role play the skill using a story instruction procedure (i.e., read, point to, pause, practice, and provide reinforcement for each step that was completed correctly). For each page of the story, while the investigator and student were still in the job coach’s office, the investigator asked the student to point to the picture or play the video, then practice what they were doing.

TABLE 2
Arrangement of Tasks and Delivery Modes across Students

<table>
<thead>
<tr>
<th>Students</th>
<th>Filing</th>
<th>Copying</th>
<th>Phone</th>
</tr>
</thead>
</table>
going to do. Each step used a simulated practice procedure; for example, students pushed their thumbs in and pulled their arms back to simulate opening the filing cabinet drawer. Finally the investigator reinforced this practice with verbal praise.

As soon as the student finished reading the storybook, the investigator asked him or her to complete the actual task using the same script as in baseline. Therefore, the delay between the LBBI session and a student’s opportunity to respond independently was negligible. For the filing and answering the phone task the student remained in the job coach’s office to complete the task; for the copying task the student had to go across the hall into the copy room. While the student completed the task, the investigator stood in the doorway, approximately five feet away. The book or tablet remained on the table open and available to the students for reference if needed. If the student referred to the book, the step was marked as correct with prompts, or as an error. If students asked for assistance with a step, they were referred to the book for directions. As in baseline, if the student did not initiate a step in the task analysis within 30 seconds of completing the previous step, the investigator reminded the participant to do what she or he had seen previously in the storybook, and a prompt was recorded. No other peers or adults provided instruction with or without the students’ storybooks.

Follow-up. After students showed mastery (defined as 100% of steps completed correctly and independently for five of six sessions), or if a student had five consecutive stable sessions with no additional progress, the intervention was stopped and the LBBI was removed to see if the gains would maintain without the intervention. During these follow-up observations, baseline procedures were replicated; students no longer read the story to an investigator or received prompts to refer to the storybooks. That is, an investigator asked each student to complete the various work skills, but no assistance or intervention was provided.

Experimental Design

The experimental design in this study combined a multiple probe design across work tasks with a variation of the adapted alternating treatments design (Wolery, Gast, & Ledford, 2014). This design arrangement followed the model used by Mechling et al. (2014) that allowed for a simultaneous analysis of differences across participants, tasks, and intervention delivery modes. The multiple probe design established a functional relation between the LBBI and the job skills performed by each student. The adapted alternating treatments design showed the comparative effects of the LBBI delivery types (paper book, e-book, and enhanced e-book) presented to the students across the various tasks. To avoid sequence effects, the three delivery modes were counterbalanced across the work tasks and students. After the intervention condition, follow-up observations were conducted for each student and work task to evaluate whether the newly learned skills would maintain in the absence of the LBBI. For the filing task, the first follow-up observations were held 7, 9, and 13 days after the last day of intervention for, Marty, Diane, and Karen respectively; the second follow-up observations were held 6 days after the first observation. For the copying task, the first follow-up observation was conducted 7, 8, and 9 days after the last day of the students’ intervention; the second follow-up session was 6 days after the first. Finally, for phone use, the first follow-up observation was conducted 12 days after intervention for Karen, and 6 days after the intervention for Marty and Diane. The second follow-up session for phone use was conducted 7 days after the first.

Data Analysis

Data were analyzed using visual inspection procedures typically used for single subject design studies. To assess the impact of the LBBI on students’ acquisition of the skills, we calculated the means for each student’s dependent measure during baseline, intervention, and follow-up. In addition, we examined ranges for each condition, and examined condition changes based on the level and trends of individual data points. We used these same data analysis procedures to compare results of the three delivery modes. For this comparison of delivery modes, we examined the data across the particular skills and students. This enabled us to examine changes regardless of
student and skill differences from (a) baseline to intervention, and (b) baseline to follow-up for each delivery mode.

We also supplemented these visual inspection procedures with an effect size estimate during a post-hoc analysis. To establish effect sizes, we calculated the Percent of Non-Overlapping Data (PND; Scruggs & Mastropieri, 2013). Although there is little consensus regarding effect size protocols for single subject studies (Ledford, Wolery, & Gast, 2014), PND has been the most common effect size estimate across three decades because it shows consistency of effects across participants, and is appropriate for conditions that do not show data outliers. For this study PND was calculated separately for baseline-to-intervention, and baseline-to-follow-up conditions.

**Results**

The effects of the LBBI, as well as the differences in job skill acquisition and maintenance in the three college students based on delivery mode of the LBBI, are shown in Figure 2 and the top half of Table 3. Overall, the LBBI was effective in increasing students’ acquisition of the skills, regardless of the particular skill, delivery mode, or student. When examining the student acquisition for each task, Figure 2 shows that for the filing task (top graph), none of the students completed more than 20% of the steps correctly and independently during baseline. When the LBBI was implemented all three students increased their accuracy and independence in performing the filing task, although only two of the three students actually showed mastery of the skill. For the copying task (middle graph), the same pattern was seen, with low levels of accuracy (0 to 20%) during baseline, followed by immediate acquisition when the LBBI was implemented. Baseline for the telephone answering task (bottom graph) was more variable, with students’ performance ranging from 9% to 38%. However when the LBBI was implemented, two of the students immediately demonstrated mastery, while the third student (Marty) required 4 days to achieve at least 90% of the steps. When the LBBI was removed, students maintained the same performance levels during their follow-up observations as they did during their final intervention sessions.

Although the LBBI was seen as having an effect on each student and job task, the study also sought to establish whether there would be differential effects of the intervention based on the three modes of delivery of the LBBI. To examine the impact of each delivery mode, the top half of Table 3 shows that each delivery mode resulted in substantial gain. When all tasks are combined, the means across the delivery modes from baseline to intervention ranged from 51% to 81% improvement. Substantial gains were also seen when comparing baseline to the follow-up condition, with means ranging from 61% to 84% improvement. In each case the impact of the e-book and enhanced e-book were similar, and outweighed the impact of the paper book. Among the individual tasks, the apparent effectiveness of the enhanced e-book overall was seen for the filing and copying tasks, but was 5 percentage points less than the e-book delivery for answering the telephone.

A second indicator of the differential effectiveness of the delivery modes is found by examining the percentage of sessions in which students performed the new tasks at a mastery level of 100% accuracy and independence during the intervention condition. When all tasks are combined, the enhanced e-book tasks resulted in the largest percentage of intervention sessions with mastery (83%), followed by the e-book (68%) and paper book (24%) delivery modes respectively. Among the individual tasks shown in Table 4 (second data column), this pattern was seen for the filing and copying tasks, but the e-book delivery mode showed the highest percentage of mastery sessions (100%) among the three modes for answering the telephone. Next, the number of intervention sessions needed for a student to reach 100% accuracy and independence on a task (first data column in Table 4) was examined as a third indicator of differential effectiveness. Students who received the enhanced e-book delivery mode reached this performance level quicker on two of the three tasks (filing and copying). For the telephone task, students using the e-book and enhanced e-book had an equal number of intervention sessions to reach mastery. For all three delivery modes, students who received instruction with the paper book took longest to reach this performance level.
Finally, the Percent of Non-Overlapping Data analysis indicated that, regardless of student and skill differences, the LBBI was effective to very effective for all three LBBI delivery modes based on standards described by Ledford et al. (2014), and Scruggs and Mas-
tropieri (2013). This was observed (a) from baseline to intervention, and (b) from baseline to follow-up. Only the paper book version of the LBBI did not result in a very effective finding. These results are found in the bottom half of Table 3.

**Discussion**

Each of the students who participated in the employment training increased their accuracy and independence on three different tasks during this study, and showed substantial progress toward mastery on these tasks. When the LBBI was removed, each student continued to perform the new skills during the follow-up observations nearly three weeks later. Just as important, each student showed learning gains regardless of the LBBI delivery format that was used. While the learning gains across multiple tasks and delivery formats were encouraging, it was equally important to note that the effect of the LBBI on learning was rapid, regardless of the format used to deliver the intervention. Of the six demonstrations of effect using the e-book or the enhanced e-book delivery format, students showed their mastery of the employment skills after six or fewer intervention sessions, and several demonstrated immediate mastery during the first intervention session. The use of the paper book was more variable. Although all three skills showed rapid improvements within two to four LBBI sessions, one of the students never achieved mastery on one of the skills (Diane achieved 60% accuracy and independence on the filing task), and a second student (Marty) achieved only 91% of the telephone skills. Taken together, these findings strengthen the evidence base for the use of LBBIIs as an instructional strategy, particularly for teaching employment skills. These findings are consistent with previous LBBI investigations (Brady, Hall et al., 2016; Brady, Honsberger et al., 2016; Bucholz et al., 2008; Hall

| TABLE 3
Performance Differences and Effect Sizes (PND) Across Delivery Modes |
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<tr>
<td><strong>Delivery Mode</strong></td>
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<td>---------------------</td>
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<tr>
<td>Mean Changes Across Conditions</td>
</tr>
<tr>
<td>Paper book</td>
</tr>
<tr>
<td>E-book</td>
</tr>
<tr>
<td>Enhanced E-book</td>
</tr>
<tr>
<td>Percentage of Non-Overlapping Data</td>
</tr>
<tr>
<td>Paper book</td>
</tr>
<tr>
<td>E-book</td>
</tr>
<tr>
<td>Enhanced E-book</td>
</tr>
</tbody>
</table>

Table 4

**Arrangement of Tasks and Delivery Modes across Students**

<table>
<thead>
<tr>
<th>Delivery Mode</th>
<th>Sessions Needed to Reach 100%</th>
<th>Intervention Sessions that Reached 100%</th>
<th>Mean Increase over Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper book</td>
<td>Did not reach 100%</td>
<td>0/7 = 0%</td>
<td>29%</td>
</tr>
<tr>
<td>E-book</td>
<td>6</td>
<td>5/10 = 50%</td>
<td>67%</td>
</tr>
<tr>
<td>Enhanced e-book</td>
<td>2</td>
<td>5/6 = 83%</td>
<td>95%</td>
</tr>
<tr>
<td>Copying</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper book</td>
<td>2</td>
<td>5/6 = 83%</td>
<td>82%</td>
</tr>
<tr>
<td>E-book</td>
<td>3</td>
<td>5/7 = 71%</td>
<td>84%</td>
</tr>
<tr>
<td>Enhanced e-book</td>
<td>1</td>
<td>5/5 = 100%</td>
<td>90%</td>
</tr>
<tr>
<td>Telephone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paper book</td>
<td>Did not reach 100%</td>
<td>0/8 = 0%</td>
<td>67%</td>
</tr>
<tr>
<td>E-book</td>
<td>1</td>
<td>5/5 = 100%</td>
<td>82%</td>
</tr>
<tr>
<td>Enhanced e-book</td>
<td>2</td>
<td>5/7 = 71%</td>
<td>77%</td>
</tr>
</tbody>
</table>
et al., 2017; Kearney et al., 2017), but extend the intervention to electronic delivery formats for the storybooks – formats that parallel the progress made with video modeling and prompting interventions during the last decade (Cihak et al., 2008; Douglas et al., 2015; Mechling, 2008; Mechling et al., 2014; Van Laarhoven et al., 2009).

Limitations

As with all research there were limitations in this study. Because all participants were in the same post-secondary program and knew one another, it is possible that they might have discussed the skills they were learning, inadvertently providing support to their peers who were also receiving instruction on the office skills. In addition, since all data were collected in an active office area on campus, the students could have observed actual employees performing the skills, and thus gained unintended opportunities for observational learning.

Finally, we evaluated the differential effectiveness of the three delivery formats using three different indicators of effectiveness. The results did not unanimously support any single format as “best”, but did support the electronic media formats as modestly more effective than the paper books. When comparing the different effects of similar treatments, it is necessary to consider whether differences in the results are large enough to be meaningful, and whether the differences are consistent across participants (Wolery et al., 2014). In this study it was clear that all of the LBBI formats were effective, although the differential effects were not always robust. Although the paper book intervention resulted in growth for all students, only one achieved criterion for mastery. Perhaps the lack of additional supports, such as the ability to zoom in and out of the picture to see details, contributed to this difference. Another possibility is that students might not have been as motivated to use the paper book as they were to use the i-Pads; this motivation difference could have resulted in decreased learning, a phenomenon observed in numerous other students (Clampa, 2014). In contrast, the e-book and enhanced e-book both resulted in all students reaching mastery across the various office skills and routines. While the variation between the e-formats is less apparent, students mastered all skills more quickly while using the enhanced e-book. Perhaps the addition of a video model or video prompt contributes to this difference. Video modeling and prompting have been repeatedly demonstrated as effective interventions for people with developmental disabilities, across a variety of media, formats, and technologies (Cihak et al., 2008; Lasater & Brady, 1995; Mechling & Gustafson, 2009; Van Laarhoven et al., 2009). Future research might include more participants and target skills to identify whether greater differences might be discovered as more experimental trials are run.

Implications for Research

Similar to previous investigations of LBBI efficacy as an instructional strategy, all three intervention formats in this study incorporated discrimination training, imitation, prompting, rehearsal, and visual models into the instructional procedures. Because there has been no attempt to isolate the effects of these instructional components, the LBBI in this and previous research is best described as an instructional package that incorporates elements of well-designed explicit instruction (Gersten, Carnine, & Woodward, 1987). Complex skills and routines are task analyzed, and each page of the story teaches an important part of the larger skill. Written information is provided along with verbal instructions and visual models of how the skills should be performed. This “story” provides students with a structured skill sequence to teach them to perform the skills and routines by following the pages of their paper and electronic books. The findings in this study do not establish whether each component of the LBBI is necessary. As future LBBI studies continue to expand the student populations, learning outcomes, and delivery formats, it might be helpful to conduct a component analysis to establish whether each of these elements is needed. For example, all of the components of the LBBI in this investigation might not fit the structure of some college programs if the students in those programs do not have didactic courses, with employment experiences and job coaches who implement explicit skill train-
ing (Grigal et al., 2012; Hart & Grigal, 2010). Students in the current study benefitted from a college program structure that provided daily supported employment training for every student with developmental disabilities who enrolled in college. In addition, as future studies examine the different delivery modes, it will be important to examine the impact of the various LBBI components on these delivery modes.

Implications for Practice

As more adults with developmental disabilities seek education and employment training through college and other postsecondary experiences, the need for effective interventions will continue to grow. Literacy-based behavioral interventions appear to be one such intervention. Like other college learners, instructional formats that incorporate mobile electronic devices, tablets, and other portable visual media appear to be effective methods of promoting knowledge and skill development in college students with developmental disabilities. The results of this study, combined with the settings and skills in previous research, suggest that LBBIIs with electronic media could be effective with a variety of other community tasks. For example, teachers, job coaches, and other professionals might use LBBIIs for residential living tasks, other employment outcomes, leisure skills, or to otherwise promote self-determination. As such, LBBIIs are emerging as a promising evidence-based practice.

References


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Electronic Essay Writing with Postsecondary Students with Intellectual and Developmental Disabilities

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Abstract: This study examined the efficacy of an electronic essay-writing strategy to improve the expository writing skills of 20 young adults with intellectual and developmental disabilities enrolled in a program at an institute of higher education in the midwest. A pretest and posttest experimental design with random assignment to treatment or control group was used to investigate the mnemonic-driven electronic writing strategy. The writing strategy supported students’ construction of essay responses using a computer. Students used the strategy and a computer word program to examine an electronically presented essay test question, plan through the construction of an electronic outline, and create and revise an electronic essay response. Pretest and posttest essay responses were evaluated through proximal and distal rubrics. Results revealed a significant positive effect for the treatment group when compared to the control group for overall essay quality including use of ideas and content, and word choice.

Writing is a complicated process and an integral form of communication. Graham and Perin (2007) asserted that “along with reading comprehension writing skill is a predictor of academic success and a basic requirement for participation in civic life and the global economy” (p. 3). The National Commission on Writing (2006) report Writing and School Reform asserted that difficulties in writing can serve as a barrier in the areas of communication, achievement in school, and success in the workplace. The National Assessment of Educational Progress (NAEP, 2011) computer-based writing assessment results for secondary students who were administered the NAEP revealed 74% of eighth graders and 73% of 12th graders fell in the below proficient range (National Center for Education Statistics, 2012). Students with and without disabilities experience difficulty in writing. These difficulties if not addressed can impede one’s success in postsecondary education programs. As individuals with intellectual and developmental disabilities (IDD) exit high school they have the option of attending postsecondary educational programs at institutions of higher education (IHEs). Currently there are approximately 246 college programs for individuals with IDD (Think College, 2016).

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of assessing effective practices (Graham, Harris, & Chambers, 2016). Graham et al. (2016) systematically evaluated 19 previously conducted reviews of writing instruction studies pertaining to K-12th grade learners with and without disabilities. Graham et al. (2016) results supported but were not limited to the following practices: (a) the incorporation of word processing with supports for 4 first- to fifth-grade students yielded a large effect size 1.46; (b) the use of writing goals for fourth- to eighth-grade students yielded a large effect size .80; (c) writing strategies that employed an explicit instruction framework was supported for 84 studies across second- to 12th grade students and yielded effect sizes that ranged from 56 to 1.59; (d) use of feedback from adults (i.e., seven studies) or peers (i.e., 10 studies) yielded effect sizes that ranged from .77 to .87; and (e) the use of self-assessment for 13 studies second- to 12th graders with an effect size of .51.

The majority of writing instruction investigations have been conducted in K-12th grade settings with students without disabilities and students with disabilities including students with learning disabilities, autism spectrum disorders, behavioral problems, intellectual disabilities, and students with attention deficit hyperactivity disorder (De La Paz, 1999; Delano, 2007; Englert, Raphael, Fear, & Anderson 1988; Graham & Harris 2003; Graham et al., 2016; Graham, McKeown, Kiuhara, & Harris, 2012; Joseph & Konrad, 2009; Lane et al., 2009; Pennington & Delano, 2012). For those students with disabilities who leave high school and enter postsecondary IHEs with difficulties in writing, it is imperative to provide evidence-based instruction in the area of writing. Graham and Perin (2007) noted that 75% of writing tasks are expository in nature for 12th graders and that the majority of college classroom writing tasks are expository. With the increase of individuals with IDD who are entering postsecondary programs at IHEs expository writing strategies should be available for students who need them. Several investigations have been conducted with college-age students with IDD and an essay writing strategy.

An essay writing strategy instruction developed by Hughes, Schumaker, and Deshler (2005), the Essay Test-Taking Strategy, is mnemonic-based, and incorporates explicit instruction. This six-step strategy uses the ANSWER mnemonic to guide students in analyzing essay questions, planning what to write, constructing an essay response, and revising/reviewing the essay response. The ANSWER mnemonic represents the following steps: (a) Analyze action words in the essay question, (b) Notice the requirements of the essay question, (c) Set up an outline, (d) Work in outline details, (e) Engine an answer, and (f) Review the answer.

The Essay Test-Taking (i.e., ANSWER) Strategy has been previously investigated in four experimental group-design studies designed to assess the utility of the strategy to improve students with disabilities’ expository essay-writing skills. Therrien, Hughes, Kapelski, and Mokhtari (2009) studied the use of this strategy with 40 seventh- and eighth-grade students with learning disabilities. The participants were randomly assigned to ANSWER intervention (n = 21) or non-intervention (n = 19) groups. The ANSWER intervention was conducted for eight 35-minute sessions. Students in both groups were administered pre- and posttests in which they were given an essay test question and asked to construct an essay response. The students’ essay responses were evaluated by scores obtained through a proximal strategy-specific rubric and a distal holistic analytical rubric. The intervention group performed significantly higher than the non-intervention group in their use of the strategy steps (i.e., analyzing the essay question and constructing and outline) measured by the strategy rubric, and in the organization, ideas, and content of their essay responses (i.e., large effect size of $d = 1.69$) measured by the analytic rubric (Cohen, 1988).

A series of three sequential experimental group studies were conducted by Woods-Groves and colleagues in order to investigate the efficacy of employing the ANSWER mnemonic-driven strategy with postsecondary students enrolled in a two-year certificate program for young adults with IDD (Woods-Groves et al., 2014; Woods-Groves, Therrien, Hua, & Hendrickson, 2013; Woods-Groves, Therrien, Hua, Hendrickson, Shaw, & Hughes, 2012). A minimum of 16 young adults with IDD (e.g., students with autism, Asperger’s Syndrome, non-verbal learning disorder, mild or moderate intellectual disabilities) partici-
pated in each study with a cumulative total of 51 students across all three investigations. The authors indicated that in each study the participants were randomly assigned to an ANSWER intervention group or a non-intervention group. The intervention groups in each study received large-group instruction in the ANSWER strategy and employed the strategy to create handwritten essays. Lessons delineated in the Essay Test-Taking Strategy manual (Hughes et al., 2005) were adapted to include lesson specific graphic organizers but maintained the explicit instruction format (i.e., modeling, guided practice with corrective feedback, and independent practice). The six ANSWER lessons were taught in a sequential mastery-based format (i.e., 80% mastery). Students were provided with folders with the ANSWER mnemonic attached to the front, graphic organizers, a histogram graph for self-grafting, and highlighters. The authors in each ANSWER study, analyzed rubric results through an Analysis of Covariance (ANCOVA) where mean posttest rubric scores were compared for the intervention and non-intervention groups with the pretest means employed as a covariate.

The ANSWER intervention consists of six lessons that can be taught through a series of instructional sessions. Woods-Groves et al. (2012) conducted the first ANSWER study that consisted of six 30-minute sessions, three times a week for 2 weeks for a cumulative total of 3 hours of instruction. The proximal strategy rubric results indicated students in the intervention group significantly outperformed the control group on overall rubric scores but only on aspects of strategy use (i.e., applying the first four steps of the strategy—analyze the essay prompt and construct an outline), $d = 2.63, p = .001$. The authors found no significant differences concerning aspects of the quality of the essay constructed (i.e., steps five and six of the strategy—creating the essay and revising the essay). As a result, the second ANSWER study conducted by Woods-Groves et al. (2013) incorporated individualized writing goals for the intervention group and a longer instructional time for the intervention (i.e., intervention time = 50 minute lessons, two days a week for 3 weeks, for a cumulative total of 5 hours). The proximal strategy rubric results revealed students in the intervention group significantly outperformed the non-intervention group in the following: (a) overall proximal strategy rubric results, $d = 1.90, p = .002$; (b) use of 1–4 strategy steps, $d = 1.85, p = .002$; and (c) steps 5–6 essay construction and revision, $d = 1.12, p = .019$. In 2014, Woods-Groves and colleagues conducted a third investigation of the ANSWER strategy to promote the construction of handwritten essay responses with young adults with IDD with the following adaptations: (a) the intervention time was further extended to ten 45 minute sessions, two days a week for 5 weeks, for a total cumulative time of 7.5 hours, (b) individualized student writing goals, (c) a proximal strategy specific rubric and distal holistic analytic rubric were employed as dependent variables, and (d) generalization and maintenance skills were assessed. Results indicated the ANSWER intervention group significantly outperformed the non-intervention group in the proximal strategy specific rubric overall results, $d = 8.63, p = .001$, strategy specific steps, $d = 15.85, p = .001$; and essay construction/revision, $d = 1.50, p = .002$. The distal analytic rubric indicated significant results in favor of the intervention group in the areas of overall score, $d = .95, p = .001$, and in the combined area of ideas/content and organization, $d = 1.44, p = .001$. According to Woods-Groves et al. (2014) students who received the ANSWER instruction were assessed 2 weeks following the end of the intervention for generalization and 13 weeks later for maintenance of skills. In the generalization phase students “performed at approximately 54.79% of their previous posttest score level” and in the maintenance phase students “performed at approximately 63.64% of their previous posttest score level” (Woods-Groves et al., 2014, p. 260).

The previous four experimental investigations of the ANSWER strategy with students with disabilities focused on the construction of handwritten essays. The aim of this current investigation was to examine the efficacy of the use of the ANSWER strategy to improve postsecondary students with IDD’s skill in constructing electronic-based essays.

The following research questions were investigated:
1. Will postsecondary young adults with IDD employ the ANSWER writing strategy when constructing their electronic essay-test responses?

2. Will there be a significant difference in how postsecondary young adults with IDD use the strategy specific aspects (Steps 1 – 4) and the essay general component aspects (Steps 5 – 6) of the ANSWER writing strategy when constructing electronic essay-test responses?

3. Will there be a significant difference in the quality of electronic essay responses for postsecondary young adults with IDD in the intervention group and those in the non-intervention group in the analytic rubric areas of ideas/content, organization, voice, word choice, sentence fluency, and conventions, respectively?

Method

Participants

The 20 participants in this study were all young adults who were in their second year of a two-year postsecondary certificate program for individuals with IDD. The postsecondary program was at a research 1 institute of higher education located in the midwest. There were (7, or 35%) females and (13, or 65%) males who participated in this study and who ranged in age from 18 to 23 years, (M = 19.55, SD = 1.36). The participants lived in rural, (8, or 40%), urban, (6, or 30%), and suburban, (6, or 30%) demographic areas. Educational diagnostic information for the participants indicated that three (15%) individuals were diagnosed with autism, one (5%) individual with Asperger’s Syndrome, two (10%) with Pervasive Developmental Disorder, six (30%) with intellectual disability, one (5%) individual was diagnosed with Down Syndrome, one (5%) individual was diagnosed with Down Syndrome, four (20%) with other health impairment, two (10%) with a severe learning disability and speech impairment, and one (5%) individual’s diagnosis was not reported.

Woodcock Johnson Achievement III (WJIII; Woodcock, McGrew, & Mather, 2001) Total Scores for all participants ranged from 20-to-102, Mdn = 74, (standard scores with a M = 100, SD = 15), while Broad Reading scores ranged from 30-to-105, Mdn = 78, (standard scores with a M = 100, SD = 15). The participants were stratified based upon their WJIII Broad Reading scores and were randomly assigned to the ANSWER strategy intervention group or the non-intervention group. A coin flip was used for random assignment to groups (i.e. heads = ANSWER strategy intervention and tails = non-intervention). An analysis of variance (ANOVA) was conducted that examined WJIII Broad Reading scores for participants in the intervention (n = 11, M = 75, SD = 15.41) and non-intervention (n = 9, M = 73.33, SD = 19.63) groups and revealed a non-significant difference between the two groups, F(1, 19) = .045, p = .834, d = .09.

Materials

The lessons delineated in the Essay Test-Taking Strategy manual (Hughes et al. 2005) were adapted and included in the design and execution of the ANSWER strategy intervention. The lessons in the Essay Test-Taking Strategy manual pertained to student handwritten essay products. Adaptations were made to convert instructional materials to an electronic form so they could be used by the teacher and students via PC desktop computers. Teacher presentation materials for respective lessons were adapted to an electronic format in Microsoft Word. During the ANSWER intervention electronic documents were shown via an overhead projector connected to a PC computer. Student instructional materials were also adapted and created in an electronic format in Microsoft Word. For each lesson, instructional materials were given to respective students via USB memory sticks. Other adaptations included in the ANSWER intervention lessons pertained to the use of the following: (a) individual student folders with the ANSWER mnemonic on the front of the folder, (b) highlighters, (c) USB memory sticks for each student that contained guided practice and independent practice passages with a “TURN IN” folder for completed work, and (d) electronic and hard copy graphic organizers for each lesson. The ANSWER mnemonic and steps are depicted in Table 1.

The original essay prompts created by
Therrien et al. (2009) and subsequently used by Woods-Groves and colleagues in three published experimental ANSWER studies (i.e., Woods-Groves et al., 2012, 2013, 2014) were employed in this investigation. The essay prompts incorporated in this study were counterbalanced and randomly assigned to participants for the pretest and posttest. Originally the essay prompts were constructed to mirror statewide writing assessment probes and pertained to the following topics: inventions and heroes/heroines. The inventions prompt stated “Inventions are all around us. Think of an invention that has been especially helpful or harmful to people. Write an essay that gives at least 3 reasons why the invention was helpful or harmful.” The hero/heroine prompt stated “Your school newspaper is printing a series of articles about heroes and heroines. Write about someone who is a hero or heroine to you. That person may be someone you know, someone you have read about, a celebrity, or a historical figure. Explain at least 3 reasons why you believe this person is someone to admire.” The following maintenance prompt was designed to mirror material presented within lessons and the Essay Test-Taking Strategy manual: “You are going to have a week away from school. What is your favorite thing you will do next week? List three reasons why this is your favorite thing to do.”

**Design and Procedures**

**Design.** An experimental design was employed via a 2-level factor, randomly assigned intervention (treatment) or non-intervention (control) groups with pretest and posttest and maintenance measures. As noted earlier, participants were stratified by their WJIII Broad Reading standard scores and a coin flip was used to assign individuals to intervention (i.e., heads) and non-intervention (i.e., tails) groups. Pretests and posttests consisted of two counterbalanced essay prompts. A separate essay prompt was employed for the maintenance measure.

**Intervention.** The Essay Test-Taking Strategy manual (Hughes et al., 2005) guidelines delineated the scope and sequence of the lessons incorporated into the ANSWER intervention. The manual instructional materials were adapted for electronic use and the participants’ reading levels. The goal of the ANSWER intervention sessions was to provide students with instruction to support their construction of well-organized essay responses to
essay test prompt questions. The students were instructed in examining respective essay prompt questions, planning and constructing an outline, and in constructing and reviewing their essay response.

The scope and sequence of the ANSWER instruction consisted of five lessons that were executed in eight sessions. Detailed lesson steps are delineated in Table 1. In the first ANSWER lesson the rational for learning the strategy was discussed with students and a commitment was obtained from the students to learn the strategy. The ANSWER subsequent lessons pertained to teaching students to “Analyze” the essay prompt question and to “Notice the Requirements” in the electronic prompt by underlining and highlighting respective parts. Next, students were taught to “Set up an Outline” and “Work in the Details” by including main ideas and pertaining details in an electronic outline. Finally, students were instructed in constructing an electronic essay response by including outline components along with an introductory paragraph, a paragraph for each main idea and respective details, and a conclusion paragraph. The last step was for students to “Review” their essay response by checking the alignment with their outline and by using the spell checker function in Microsoft Word Office. The graphic organizer employed in instruction contains each ANSWER step and is depicted in Figure 1.

For each lesson the instructor followed an adapted script from the Essay Test-Taking manual. Each script included an advance organizer and an explicit instruction format that included the following components: (a) modeling, (b) thinking aloud methods coupled with guided practice, (c) immediate corrective feedback, (d) independent practice, (e) students’ self-graphing their own performance. For each session students were given USB memory sticks with a guided practice passage for whole class and instructor practice, corrective feedback passage, and an independent passage. The USB memory sticks also each had a TURN IN folder for completed work.

Each student was given a folder for each session that had the ANSWER mnemonic on the front of the folder and a step-by-step guide for how to use the USB memory stick to access and save files attached to the back of the folder. On the inside of the student folder a bar graph was attached so students could graph their graded independent work. The students evaluated their own engagement, through a point booklet and earned participation points each lesson based upon following class expectations (e.g., arrive to class on time, show respect to peers and teachers). A hard copy graphic organizer was given to each student for each session’s lesson components.

The ANSWER strategy six steps were presented in a sequential format with each step being taught to 80% mastery (i.e., determined by independent work) before the next strategy step was introduced. Student goals were individualized with regard to essay construction with some students writing multiple paragraphs while some students constructed a single paragraph.

Throughout the sessions two raters collected treatment integrity data. Each of the sessions’ lesson steps were delineated on respective lesson checklists. The raters checked steps as completed if the steps were observed by the raters during sessions.

**Intervention group.** As previously noted, students were randomly assigned to the intervention (treatment) group prior to the beginning of instruction. Each ANSWER session was 40 minutes in duration. There were eight sessions that were conducted once a week for 8 consecutive weeks. The total time for the duration of the intervention instruction was 6 hrs 40 min. The intervention instruction occurred during the students normally scheduled academic activities and was conducted in a large group setting within a computer lab. Each student was provided with a desktop PC and instructional materials. The instructor had a projector, and PC at the front of the class where instruction was conducted. The instructor had an undergraduate degree in language arts and was a certified general education teacher who was employed by the postsecondary program. The first author met weekly with the instructor to review each lesson and materials prior to instruction.

**Non-intervention group.** Students who were randomly assigned to the non-intervention (control) group participated in science instruction at the same time the ANSWER intervention was being conducted. Science instruction was conducted once a week for a period
of 40 min. for 8 consecutive weeks. All students in the intervention and non-intervention groups participated in their postsecondary delineated coursework. Common courses included instruction in finance, current issues, and vocational internships.

**Dependent variables.** The intervention and non-intervention groups’ pretest and posttest responses to the essay prompts were assessed via the strategy scoring rubric. This rubric had been previously used as a dependent measure in the four published experimental ANSWER studies (Therrien et al., 2009; Woods-Groves et al., 2012, 2013, 2014) and is depicted in Figure 1. The strategy scoring rubric is a tool to assign scores that could range from 0 to 6 for a possible total score. The rubric is aligned to match to specific ANSWER strategy steps. Steps 1 through 4 pertain to (strategy specific steps) analyzing the essay prompt and to set-
ting up an outline and can be scored a range of 0 to 4 points. Steps 5 through 6 are delineated in the rubric (general component steps) and pertain to the construction of the essay response and reviewing the essay response with possible scores ranging from 0 to 2 points. See Figure 2 for the strategy scoring rubric. Two graduate student raters employed the strategy specific rubric to evaluate the pretest and posttest essays and maintenance essays that were constructed by the students. The mean of the raters’ responses were calculated for the strategy specific steps (1 through 4), the general component steps (5

### Strategy Scoring Rubric

**Strategy Specific Components**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analyze the Action Words (1 each)</td>
<td>___ / 1</td>
</tr>
<tr>
<td></td>
<td>Were the key action word(s) underlined once?</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Notice the Requirements (1 each)</td>
<td>___ / 1</td>
</tr>
<tr>
<td></td>
<td>Were the requirements underlined twice?</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Set Up an Outline (.5 each)</td>
<td>___ / 1</td>
</tr>
<tr>
<td></td>
<td>Was an outline constructed?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Did the main points/ideas in the outline match the requirements in the question?</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Work in Details (1 each)</td>
<td>___ / 1</td>
</tr>
<tr>
<td></td>
<td>Were relevant details listed under the main points in the outline?</td>
<td></td>
</tr>
</tbody>
</table>

**Essay General Components**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Engineer Your Answer (.2 each)</td>
<td>___ / 1</td>
</tr>
<tr>
<td></td>
<td>Was there an Introductory Sentence or Paragraph?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Did the Introductory Sentence or Paragraph contain a rephrase of the question?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Was there a sentence for each requirement in the question?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Did all sentences pertain to the topic?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Was there a concluding sentence (summary)?</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Review Your Answer (.5 each)</td>
<td>___ / 1</td>
</tr>
<tr>
<td></td>
<td>Were all outlined items included?</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Was the question adequately answered?</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL SCORE**

\[ \text{Points Earned} \div \text{Total Points} = \% \]

Figure 2. Strategy Scoring Rubric (adapted from Therrien et al. [2009], Woods-Groves et al. [2012], Woods-Groves et al. [2013], Woods-Groves et al. [2014]).
through 6), and the overall total score (steps 1 through 6).

The second dependent measure was used by the raters to provide a more stringent evaluation of the students’ constructed essays. This measure was a holistic analytic scoring rubric developed by the Oregon Department of Education and denoted as an “Official Scoring Guide” (Oregon Department of Education, 2004–2005). This measure had been used in two previous experimental investigations of the ANSWER strategy (i.e., Therrien et al., 2009; Woods-Groves et. al., 2014) and provided an evaluative criteria similar to often used state writing assessments (Isaacson, 1996). Six domains were evaluated with this rubric which included: ideas and content, organization, voice, word choice, sentence fluency, and conventions. Each domain could receive a score that ranged from 0 to 6 with 6 indicating the highest quality.

Data collection. Following the random assignment of students to the intervention and non-intervention groups, all students were administered a pretest with counterbalanced prompts (prompt 1 and prompt 2). A posttest was administered one week following the conclusion of ANSWER instruction. The posttest was given to all students. A maintenance prompt was administered to all students 2 weeks following the end of ANSWER strategy instruction. Two graduate students enrolled in the doctoral program in special education used the strategy rubric and the analytic rubric to evaluate de-identified pre- and posttest essays, and maintenance essays. The raters did not have knowledge of the ANSWER strategy instruction or if the essays were from students in the intervention group or non-intervention group. The first author trained the student raters in how to use the respective rubrics to evaluate the students’ completed essays. The raters practiced using the rubrics to evaluate essays and met to discuss their ratings with each other while they were evaluating the essay responses.

Data Analysis

The software G power 3 (Faul, Erdfelder, Lang, & Buchner, 2007) was used to conduct a power analysis. Previous experimental studies for the ANSWER strategy reported Cohen’s $d$ effect sizes that ranged from $d = .95$ to $d = 15.85$ (Therrien et al., 2009; Woods-Groves et al., 2012, 2013, 2014). The power analysis was conducted with a large effect size of .80, an alpha of .05, and .80 for power. The results indicated that a total sample size of 15 would be adequate ($N = 14.6429 = 15$). Additional analyses were conducted via IBM SPSS 23 (2016). A series of analysis of variance (ANOVAs) were used to compare pretest strategy and analytic scoring rubric results from intervention and non-intervention groups. An analysis of covariance (ANCOVAs) with pretests as the covariates strategies were used to examine the strategy and analytic scoring rubrics posttest results for the intervention and non-intervention groups. The strength of statistically significant findings (effect sizes) were calculated and then evaluated via Cohen (1988) classification standards (i.e., .2 = small, .5 = medium, and .8 = large).

Results

Treatment Integrity and Inter-Rater Reliability

For each of the eight ANSWER sessions treatment integrity was collected via two raters completing respective lesson related checklists. Each checklist contained the content and steps to be included in each session. For seven of the eight lessons two raters agreed 100% with regard to content and steps completed in each session. For one session treatment integrity was collected by one rater due to scheduling conflicts. Treatment integrity for this session indicated 100% compliance.

Interrater agreement for the two raters’ results from the strategy scoring rubric and the analytic scoring rubric was calculated via bivariate correlations. Correlations were examined for the two raters’ scores via the respective rubrics (i.e. strategy scoring rubric and the analytic rubric) for the pretests, posttests, and maintenance. Correlations for the strategy scoring rubric results across essay prompts between raters ranged from $r = .89$ to 1.00, $mdn = .99$. For the analytic rubric results for pretest and posttest correlations between the two raters ranged from $r = .91$ to .98, $mdn = .95$. For the analytic rubric raters’ results for the maintenance essay responses correlations ranged from .73 to .87, $mdn = .79$. 
**Posttest Measures**

**Strategy-specific rubric.** The differences between the treatment and control groups’ posttest essays were examined using a series of ANCOVAs. The results for the overall strategy rubric between the treatment and control groups were statistically significant with a large effect size for the treatment group ($p = .008, d = 1.33$). The strategy-rubric components were broken down into two parts to further examine what might account for the significant difference. The strategy-use components (steps 1–4) for the treatment group were significantly higher, with a large effect size ($p = .012, d = 1.31$). For the general components (steps 5–6), the treatment group significantly outperformed the control group, with a large effect size ($p = .021, d = .90$). Table 2 details the means, standard deviations, $p$ values, effect sizes, ANOVA, and ANCOVA results for the strategy-scoring rubric for the pre- and posttests.

**Analytical-scoring rubric.** The participants’ posttest essays responses were evaluated using a 6-point scale that ranged from 1 for the lowest point to 6 for the highest. The rubric includes six analytic areas: ideas/content, organization, voice, word choice, sentence fluency, and conventions. The ANCOVA posttest results, with pretests as the covariate, for the intervention and non-intervention group responses were significant in favor of the intervention group for “ideas/content” and “word choice” with large effect sizes of $p = .039, d = .71$ and $p = .011, d = .86$, respectively. However, non-significant results were revealed for the rest of the analytic rubric areas. Table 2 details the mean values, standard deviations, $p$ values, effect sizes, ANOVA, and ANCOVA results for the analytic rubric for the pre- and posttests.

**Maintenance.** A maintenance essay prompt was administered 2 weeks after the ANSWER strategy intervention was completed. The ANSWER strategy was not reviewed. An electronic Word document that contained the essay prompt was loaded on the PC desktop for each student in a large group format. The graduate students’ mean strategy scoring rubric scores for the intervention group and non-intervention group were examined via ANCOVAs with the pretests as the covariate. The overall rubric total revealed that the intervention group significantly outperformed the non-intervention group, $p = .001, d = .2.26$. For strategy use and general components the intervention group, significantly outperformed the non-intervention group $p = .001, d = 2.32$, and, $p = .004, d = 1.40$, respectively. The intervention group significantly outperformed the non-intervention group in the analytic rubric rating for word choice, $p = .036, d = .68$. A comparison of intervention and non-intervention groups revealed non-significant results for the analytic rubric ratings for ideas/content, organization, voice, sentence fluency, and conventions. Table 3 depicts ANCOVAs, Mean, SD, effect sizes, and $p$-values for maintenance comparisons.

**Discussion**

This study investigated the efficacy of the ANSWER strategy to improve electronic essay writing skills of college students with IDD. Students who were taught the ANSWER strategy once a week for 8 weeks (i.e., a total of 6 hrs 40 min.) used the strategy steps as they constructed their essay test responses. Students in the treatment group improved their essay writing skills in the areas of overall essay quality, the use of ideas and content, and word choice when compared students in the control/non-intervention group. In the 2 weeks following the end of ANSWER instruction, students in the treatment group maintained their skills in overall essay quality that included strategy use, quality construction of the essay responses, and word choice when compared to the control group. The results from the proximal (i.e., Strategy Rubric) and distal (i.e., Analytic Rubric) were similar to those found in Woods-Groves et al. (2014) where significant effects were found for the treatment group for both metrics for college students with IDD where students who were taught the answer strategy constructed better quality essay responses than students who were not taught the strategy.

The four previous experimental ANSWER studies instructed students in constructing hand written essay outlines and essay responses. In Therrien et al. (2009) middle schoolers with LD who were taught the ANSWER strategy sig-
<table>
<thead>
<tr>
<th></th>
<th>Overall Strategy Rubric Total</th>
<th>Strategy Use 1–4 Steps</th>
<th>General Components 5–6 Steps</th>
<th>Ideas</th>
<th>Content</th>
<th>Organization</th>
<th>Voice</th>
<th>Word Choice</th>
<th>Sentence Fluency</th>
<th>Conventions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pretest</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C (9)</td>
<td>1.87* (.83)</td>
<td>.00* (.00)</td>
<td>1.87* (.83)</td>
<td>3.34*</td>
<td>(1.35)</td>
<td>2.67* (1.33)</td>
<td>3.34*</td>
<td>(1.00)</td>
<td>2.89* (1.27)</td>
<td>3.12* (1.06)</td>
</tr>
<tr>
<td>T (11)</td>
<td>2.01* (.92)</td>
<td>.00* (.00)</td>
<td>2.01* (.92)</td>
<td>3.37*</td>
<td>(1.29)</td>
<td>3.14* (1.19)</td>
<td>3.74*</td>
<td>(1.04)</td>
<td>3.24* (1.13)</td>
<td>3.28* (1.43)</td>
</tr>
<tr>
<td><strong>ANOVA</strong></td>
<td>F(1, 19) = .128 p = .725ns</td>
<td>F(1, 19) = .000 p = NA</td>
<td>F(1, 19) = .128 p = .725ns</td>
<td>F(1, 19) = .003 p = .959ns</td>
<td>F(1, 19) = .701 p = .413ns</td>
<td>F(1, 19) = .610 p = .445ns</td>
<td>F(1, 19) = .048 p = .537ns</td>
<td>F(1, 19) = .397 p = .959ns</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Posttest</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>C (9)</td>
<td>1.74* (1.37)</td>
<td>.00* (.00)</td>
<td>1.74* (1.37)</td>
<td>3.00*</td>
<td>(1.55)</td>
<td>2.73* (1.40)</td>
<td>2.89*</td>
<td>(1.58)</td>
<td>2.62* (1.27)</td>
<td>2.73* (1.35)</td>
</tr>
<tr>
<td>T (11)</td>
<td>4.78* (2.92)</td>
<td>1.87* (2.01)</td>
<td>2.91* (1.20)</td>
<td>4.05*</td>
<td>(1.39)</td>
<td>3.96* (1.36)</td>
<td>3.96*</td>
<td>(1.32)</td>
<td>3.60* (1.99)</td>
<td>3.41* (1.34)</td>
</tr>
<tr>
<td><strong>ANOVA</strong></td>
<td>F(1, 18) = 9.19 p = .008**</td>
<td>F(1, 18) = 7.428 p = .012**</td>
<td>F(1, 18) = 6.506 p = .021**</td>
<td>F(1, 18) = 4.992 p = .039**</td>
<td>F(1, 18) = 3.085 p = .097**</td>
<td>F(1, 18) = 1.965 p = .179**</td>
<td>F(1, 18) = 8.064 p = .011**</td>
<td>F(1, 18) = 9.32 p = .548ns</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * Denotes mean values, C group (9) = control, number of non-intervention participants, T group (11) = treatment, number of intervention group participants. Standard deviations are provided in parentheses, ns = non-significant. ** = significant. d = Effect size, Cohen's d.
Woods-Groves et al. (2012) revealed that college students with IDD learned and applied the ANSWER strategy. Woods-Groves and colleagues conducted two additional studies that supported the use of the ANSWER strategy to improve the quality and organization of college students with IDD’s essay responses (Woods-Groves et al., 2013, 2014). This experimental study examined the use of the ANSWER strategy in an electronic format where students applied the steps of the strategy when presented with an essay question in a word document via a desktop computer. The students analyzed the action words and noticed the requirements by underlining and highlighting the essay prompt question, constructed an electronic outline, constructed an essay response, and revised their response all through their word document and desktop computer.

Limitations and Future Research

There were several limitations to this study. First, students in the study would have generalized their essay writing skills. Future studies should examine the ANSWER strategy’s use in different contexts where expository writing tasks are assigned such as in-person college classes in different TABLE 3

ANSWER Strategy Maintenance 2 Weeks Following Instruction

<table>
<thead>
<tr>
<th>Overall</th>
<th>Strategy Use</th>
<th>General Components</th>
<th>Ideas Content</th>
<th>Organization</th>
<th>Voice</th>
<th>Word Choice</th>
<th>Sentence Fluency</th>
<th>Conventions</th>
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<tbody>
<tr>
<td>Main</td>
<td>Rubric Total</td>
<td>1–4 Steps</td>
<td>5–6 Steps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C (9)</td>
<td>1.23* (.98)</td>
<td>1.23* (1.08)</td>
<td>2.78* (1.18)</td>
<td>2.95* (1.08)</td>
<td>3.34* (1.07)</td>
<td>3.06* (.89)</td>
<td>2.78* (1.07)</td>
<td>3.06* (1.02)</td>
</tr>
<tr>
<td>T (11)</td>
<td>5.80* (2.64)</td>
<td>2.89* (1.76)</td>
<td>2.92* (1.32)</td>
<td>3.82* (1.35)</td>
<td>3.96* (1.51)</td>
<td>3.78* (1.15)</td>
<td>3.73* (1.06)</td>
<td>3.37* (0.98)</td>
</tr>
<tr>
<td>d</td>
<td>.226</td>
<td>.325</td>
<td>1.40</td>
<td>.82</td>
<td>.76</td>
<td>.39</td>
<td>.68</td>
<td>.30</td>
</tr>
</tbody>
</table>

ANCOVA

- F(1, 18) = 24.012
- F(1, 18) = 10.885
- F(1, 18) = 5.871
- F(1, 18) = 1.950
- F(1, 18) = 293
- F(1, 18) = 5.162
- F(1, 18) = .737
- F(1, 18) = .555

Note: * Denotes mean values, CI group (9) = number of non-intervention participants, I group (11) = number of intervention group participants, Standard deviations are provided in parentheses, ns = non-significant. d = Effect size, Cohen’s d.
subject areas, in one-to-one tutorial services, and through online college coursework assignments.

Implications for Practice

MacArthur, Graham, and Fitzgerald (2016) noted that “writing is critical to the advancement of knowledge in academic, technical, and business fields…” (p. 1). Students with and without disabilities who experience difficulties in written expression throughout their secondary settings oftentimes will enter college or the workforce ill prepared to complete core aspects of their educational program or job. It is essential that teachers use evidence-based strategies in writing instruction. As noted earlier, 75% of writing tasks are expository for 12th graders, with that proportion increasing in college (Graham & Perin, 2007). With the majority of secondary students in eighth and 12th grades who were assessed via the NAEP falling in the non-proficient range in the area of writing there is a need to employ effective writing practices in the classroom. The writing process is iterative in nature and involves metacognition, motivation, and can be context dependent (Hayes, 1996; 2012; Hayes & Flower, 1980). Individuals write for many purposes and within many contexts. Components of the ANSWER strategy are undergirded by previous empirical work reviewed by Graham et al. (2016) in the area of writing (i.e. use of explicit instruction, self-assessment through goal setting and graphing, use of feedback during guided practice, using word processing in writing). Within secondary and college classrooms students are called upon to construct text in an electronic format and are oftentimes assessed via computer-based platforms where they construct quality of essay responses. When differentiating instruction it is beneficial for educators to identify and use strategies that can be effective for all learners. The efficacy of the ANSWER strategy has been supported through five experimental group studies that included middle schoolers with LD or college students with IDD. These studies support the use of the ANSWER strategy as an instructional method that has been effective in improving the quality of essay test responses.

This current investigation extended previous work pertaining to the ANSWER strategy and handwritten essay responses to embedding the strategy in an electronic-based format. It is important to support 21st century learners with and without disabilities who struggle in written expression with instruction that includes pre-planning, essay construction, and revision of text within a word processing or equivalent electronic format. For college students with IDD who struggle in writing and who are entering IHEs it is imperative to provide effective instruction in a timely manner. We encourage future exploration of the efficacy of ANSWER strategy in improving essay writing for secondary and college-age students with disabilities who experience difficulties in writing.

References


Graham, S., Harris, K. R., & Chambers, A. B., (2016). Evidence-based practices and writing in-


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Teaching Students with Autism and Intellectual Disability to Solve Algebraic Word Problems

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Abstract: This study used modified schema-based instruction (MSBI) to teach mathematical word problem solving to three students with ASD in fifth and sixth grade. Following explicit strategy instruction, the participants learned to use an 8-step task analysis and a graphic organizer to solve and discriminate between math word problems requiring algebraic reasoning. A multiple probe across participants design was used to establish a functional relation between MSBI and word problem solving, with a non-parametric measure (Tau-U) confirming visual analysis of a large effect (.87). Results indicated students increased the number of steps of the task analysis solved independently correct, total problems solved, and discrimination of problem type. Implications for practice and future research are discussed.

State standards like the Common Core State Standards Mathematics (CCSSM) help educators set targets for mathematical learning experiences. One domain of mathematics emphasized throughout grade levels in the CCSSM is algebra (Common Core State Standards Initiative, 2015). Algebraic reasoning serves as a bridge for the “cognitive gap” students often experience between arithmetic and algebra (Herscovics & Linchevski, 1994; Witzel, 2016). The foundations of algebraic reasoning are laid in early elementary grades as children learn to form generalizations about numbers, notice patterns, and reason about equivalence (Van de Walle, Karp, & Bay-Williams, 2016). For example, identifying whether two groups of objects have an equal quantity of items is an essential prerequisite skill to understanding properties and solving equations. This skill is necessary when deciding whether a given quantity is “enough” or “not enough” for a given task and what further steps might need to be taken. Reasoning is a defining feature of mathematics and is essential for conceptual understanding (NCTM, 2000).

There is a relationship between algebraic reasoning and word problem solving. Powell and Fuchs (2014) found second grade students who struggled with word problem solving performed lower on algebraic reasoning tasks than students who had difficulty with calculation alone. Problem solving experiences in school settings are typically structured in the format of story problems. In the context of word problem solving, stories present situations requiring a mathematical solution (Stein, Kinder, Silbert, & Carnine, 2006). Learning to solve word problems is the basis for learning to solve real-world problems (Van de Walle et al., 2016). Consideration of the “school effects” of mathematics highlights the need for high quality instruction, as school is likely to be the only context in which students receive instruction in mathematics, unlike literacy or reading (Van de Walle et al., 2016).

Students with mathematical difficulties, including those with autism spectrum disorder (ASD), need explicit instruction on learning strategies in order to make progress in algebraic problem solving. Jitendra and colleagues (2015) established learning strategies that prime the problem structure as an evidence-based practice for teaching mathematical problem solving to students with mathematical difficulty. Two learning strategies that are schema-broadening instruction and schema-based instruction. Both schema-broadening and schema-based instruction use explicit instruction to teach...
students to conceptually understand the structure of problems and traditionally use mnemonics, such as RUNS (Read the problem, Underline key information, Name problem type, Solve) or FOPS (Find the problem type, Organize the information using diagram, Han to solve the problem, Solve the problem) to procedurally solve the problem. Fuchs et al. (2014) used a schema-broadening approach that explicitly taught students the underlying structure of three additive problem types (e.g., group, change, and compare) using real-life scenarios. Students were taught a systematic process for using an equation to analyze components of word problems and represent them using mathematical terms and symbols. Fuchs et al. (2014) found explicit word problem solving instruction that primed the problem structure had a greater effect on pre-algebraic knowledge for elementary students than calculation based instruction. Both schema-broadening and schema-based instruction involve instructional strategies that address the barriers to success in mathematics faced by students with ASD (Rockwell, Griffin, & Jones, 2011).

The unique learning characteristics of individuals with ASD related to working memory, executive functioning, and language contribute to their difficulties with word problem solving. According to Kintsch and colleagues (Cummins, Kintsch, Reusser, & Weimer, 1988; Kintsch & Greeno, 1985; Nathan, Kintsch, & Young, 1992), word problem solving is an interaction between problem-solving strategies and language comprehension processes. For students with ASD, deficits in working memory, executive functioning, and language create barriers to both conceptual understanding of what is happening in word problems as well as creating and carrying out a procedural plan for solving the problem. In addition, many individuals with ASD have below average mathematics word problem solving and calculation skills (Wei, Christiano, Jennennifer, Wagner, & Spiker, 2014) and nearly 25% of students with ASD have a mathematics learning disability (Mayes & Calhoun, 2006). Comorbidity of ASD and an intellectual disability (ASD/ID) likely negatively effects problem solving abilities, as these students have deficits in the necessary component skills of word decoding, mathematical vocabulary, computation, and everyday mathematical knowledge (Bae, Chiang, & Hicokinon, 2015).

Recent research has found modified schema-based instruction (MSBI) effective in overcoming the barriers to problem solving faced by individuals with ASD/ID (Spooner, Saunders, Root, & Brosh, 2017). MSBI teaches conceptual and procedural knowledge by combining traditional schema-based instruction with established evidence-based practices for teaching mathematics to students with severe disabilities, including systematic prompting and use of a task analysis (Browder, Spooner, Ahlgrim-Delzell, Harris, & Wakeman, 2008; Spooner, Root, Saunders, & Browder, 2018). While semantic diagrams are an essential component of schema-based instruction, MSBI provides students with graphic organizers as a visual support, which is an evidence-based practice for students with ASD (Wong et al., 2014) and is recommended by Barnett and Cleary (2016) as a strategy for increasing the success of students with ASD with algebraic problem solving.

Through a series of single-case designs, Browder and colleagues evaluated the effects of MSBI on the mathematical problem solving of 10 elementary and 13 middle school students with developmental disabilities, including 14 students with moderate ID and nine with ASD/ID (Browder et al., 2018; Root, Browder, Saunders, & Lo, 2017; Root & Browder, 2017; Root, Saunders, Spooner, & Brosh, 2017; Saunders, 2014; Saunders, Spooner, & Ley Davis, 2018). Results of supporting studies have found MSBI to be effective in teaching one-step additive problems (group, change, and compare), including one study that taught algebraic word problems (Root & Browder, 2017).

Root and Browder (2017) taught three middle school students with ASD/ID to use an electronic task analysis to solve algebraic word problems with the missing information in both the medial (i.e., 3 + x = 5) and final (i.e., 3 + 2 = x) positions. Following guidelines of Spooner, Saunders, et al. (2017) word problems depicted quantities less than 10 and participants used manipulatives on the graphic organizer to solve the problems. A functional relation was found between MSBI and problem solving, but participants had limited generalization of problems with missing
information in the medial position when visual supports were faded. This may have been due to limited conceptual understanding of the difference between the two problem types, as they were taught simultaneously with no explicit discrimination training.

While there is some empirical support for the use of MSBI to teach problem solving to students with ASD/ID, existing studies have several limitations that place boundaries on generalization of problem solving. First, all studies taught problem solving with quantities less than 10 in accordance with the early numeracy skills of participants. As such, manipulatives were used as concrete representations to procedurally solve the problem. Although manipulatives are an evidence-based practice for students with moderate/severe disability (Spooner, Root, et al., 2018), their use is not feasible with larger quantities. There are many real-world applications of mathematical problem solving that require computation with quantities above 10. Given its emerging record of success for teaching problem solving to students with ASD/ID, further research is warranted on the feasibility of MSBI to address algebraic reasoning and problem solving with quantities above ten and discrimination of problem types. Therefore the purpose of this study was to evaluate the effects of MSBI on solving problems that require algebraic reasoning by students with ASD by addressing the following research questions:

1. What is the effect of modified schema-based instruction on algebraic word problem solving of students with ASD?
2. What is the effect of modified schema-based instruction on discrimination of problem type by students with ASD?

Method

Participants

Approval from Institutional Review Board was received prior to recruitment. Students were recruited using teacher nomination and were eligible to participate based on the following inclusion criteria: (a) an educational or medical diagnosis of ASD and (b) satisfactory performance on a pre-screening measure. The prescreening tool evaluated student’s ability to (a) identify double digit numbers, (b) add and subtract single and double digit numbers, (c) write numbers using a pencil, and (d) solve one-step word problems. Performance on the prescreening measure was considered satisfactory if participants were able to complete items a, b, and c with 100% accuracy and no more than 20% accuracy on item (d). Three students with ASD participated in the study. Prior to the beginning of the study, all participants were administered the mathematics battery from Woodcock Johnson Tests of Achievement, 3rd edition (WJ-III; Woodcock, McGrew, & Mather, 2001) by the second author.

Ricky was a 10-year-old Caucasian male with a combined diagnosis of ASD level 1, ADHD, and Obsessive Compulsive Disorder from a physician. Standardized assessment information regarding Ricky’s cognitive or adaptive functioning was not available. He enjoyed talking with peers and familiar adults and was quick to advocate for himself, such as by saying “I can do that” or “No thanks”. Ricky had an overall mathematical standard score of 66 (1st percentile) on the WJ-III. He had strengths in calculation with a standard score of 83 (13th percentile) and weaknesses in applied problems with a standard score of 63 (1st percentile).

Kelly was an 11-year-old Caucasian female with a diagnosis of ASD level 2, language impairment, and mild intellectual disability from a physician. Standardized assessment information regarding Kelly’s cognitive or adaptive functioning was not available. Kelly enjoyed being with peers and adults would greet people who entered the room. Kelly often talked using delayed echolalia phrases such as “Did you get the mail today?” She could respond to questions and directions asked by teachers. Kelly had an overall mathematical standard score of 60 (<1st percentile) on the WJ-III. She had strengths in calculation with subtest standard scores of 81 (10th percentile) and weaknesses in applied problems with a standard score of 55 (<1st percentile).

Marc was a 12-year-old Caucasian male with a combined diagnosis of ASD level 3, ADHD, and a mild intellectual disability from a physician. Marc’s most recent comprehensive evaluations indicated an IQ score of 58 on the Stanford-Binet Intelligence Scales, 5th edition.
Marc interacted with peers and adults within the classroom through greetings and asking questions. He could respond to questions and requests asked by teachers. At times, Marc’s speech was repetitive if his communication partner did not follow the pattern (e.g. Marc would keep saying “How are you?” if you the other person did not say “And how are you?”). On the WJ-III, Marc had an overall mathematical standard score of 25 (<1st percentile). Although his performance was in <1% percentile, Marc had a higher standard score in the area of applied problems (46) compared to calculation (20).

Setting

This study took place at a private school for students with ASD located in the southeastern United States. Participants were in the same multi-grade classroom. They participated in daily instruction from a female non-certified teacher who was trained as a registered behavior technician (RBT) and was working to complete requirements to become a Board Certified assistant Behavior Analyst (BCaBA). Several teacher assistants who were also RBTs were present in the classroom throughout the day. Participants were engaged in approximately 60 min of daily mathematics instruction from the classroom teacher using free online materials from Engage NY (New York State Education Department, 2017; www.engageNY.org) aligned to 3rd to 5th grade Common Core State Standards.

Intervention sessions were conducted one on one between the interventionist and participant approximately four days per week in a small quiet classroom free from visual and auditory distractions. Each session lasted approximately 10 min. The first and second authors were both interventionists. The first author has a doctorate in special education, is a Board Certified Behavior Analyst (BCBA), and former special education teacher. The second author was a doctoral student in special education and a former special education teacher.

Materials

Student materials included an 8-step task analysis (TA), worksheets and pencils with erasers. Each page of the worksheet had one word problem (either missing-whole or missing-part), a graphic organizer, and a structure for equations. The word problems were all of the “group” problem type, which consist of two small groups that can be combined to create one large group (Carpenter & Moser, 1984). These problems reflect a part-part-whole relationship. Group problems can be written either as addition problems, where the known variables are the small groups, or as a subtraction problem where the known variables are the large group and one of the small groups. For example, the problem “Jack had comic books on his iPad. Jack has 15 superhero comic books. Jack has 10 anime comic books. How many comic books does he have on his iPad altogether?” would be solved by writing the equation $15 + 10 = X$, with the “missing” information located in the final position. This problem type was characterized as ‘missing whole’ (MW) for the purpose of the study. The same problem could be rearranged to have the missing information in the initial or medial position; “Jack had comic books on his iPad. Jack had 15 superhero comic books and some anime comic books. If he has 25 total comic books, how many are anime?” This problem would be solved by writing the equation $15 + X = 25$. It could also be solved as $25 - 5 = X$. These problems were characterized as ‘missing part’ (MP) for the purpose of this study. Word problems were written following guidelines provided by Spooner, Saunders, et al. (2017) and used quantities above 10.

In addition to the word problem, each page of the worksheet also had a pre-drawn graphic organizer (see Figure 1). This graphic organizer had two small circles above one larger circle. At the bottom of the worksheet was an additional visual support to help participants line up vertical equations which consisted of six empty squares aligned in three rows of two with a solid bar for the equal sign and an empty circle for the operation sign to the left of the middle row of boxes. An 8-step TA was printed on a separate piece of 8.5” × 11” paper. Participants used a new TA for each problem. Each step of the TA had a picture to support understanding and a space to check off each step as it was completed to promote self-management. See Table 1 for the steps of the TA and expected student responses.
A multiple probe across participants design was used to demonstrate a functional relation between the mathematics intervention and the primary dependent variable (Horner & Baer, 1978). All three participants entered baseline together and were continuously probed. The implementation of the design adhered to the criteria established by the What Works Clearinghouse (WWC; Kratochwill et al., 2013). There were three experimental conditions: baseline, intervention, and probe. The intervention consisted of three phases: missing whole (MW), missing part (MP), and discrimination. A three-session probe was conducted between each intervention phase. After the first participant (Ricky) showed a clear accelerating trend or improved level of a minimum of three data points in the primary dependent variable during missing-
whole intervention, the second participant (Kelly) entered intervention. Following mastery in each intervention phase, participants were probed for three sessions to measure maintenance of treatment effects and generalization of effects to the other problem type.

Dependent variable. The primary dependent variable was mathematical problem solving, measured by the number of steps of the 8-step TA competed independently correct. Although the TA consisted of eight steps, the final step (solve and write answer) was worth two points, one for each separate behavior (see Table 1). Participants solved two problems of the targeted problem type in each session, for a total of 18 available points for each problem type in each session. The second dependent variable, discrimination of problem type, was only measured in baseline and probe trials when no prompting and feedback were provided. Discrimination of problem type was defined as participants selecting the appropriate operation (addition for missing-whole, subtraction for missing-part). Participants had the opportunity to solve two problems of each problem type during baseline and probe sessions for a total of four opportunities for discrimination in each session.

Interobserver agreement and procedural fidelity. To ensure reliability and fidelity, interobserver agreement (IOA) and procedural fidelity data were collected across all experimental conditions. Both in vivo and permanent product (video) observations were used. The second observer (third author) was trained to fidelity and 100% agreement across both measures was reached via both role playing and observation of participant videos.

The second observer collected IOA during for 60% of baseline sessions for Ricky (three out of five sessions), 42% of baseline sessions for Kelly (three out of seven sessions), and 37% of baseline sessions for Marc (three out of eight sessions). The agreement was 100% for all three participants during baseline. The second observer collected IOA during at least 20% of all probe and intervention sessions, including at least once in each phase/probe. IOA was collected for 36% of intervention and probe sessions for Ricky (seven out of 19 sessions), 50% of intervention sessions for Kelly (nine out of 18 sessions), and 35% of intervention sessions for Marc (12 out of 34 sessions). Mean agreement for intervention and probe sessions was 98% (range 90–100) for Ricky, 97% for Kelly (range 90–100), and 97% (range 80–100) for Marc.

The second observer used a procedural fidelity checklist to document the degree to which the intervention was implemented consistently as designed. For each step of the task analysis, the second observer evaluated the following actions of the interventionist:

### TABLE 1

<table>
<thead>
<tr>
<th>Step</th>
<th>Expected Student Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Read the problem</td>
<td>Read problem or ask for problem to be read</td>
</tr>
<tr>
<td>2. Circle the groups</td>
<td>Circle the whole (“big group”) and parts (“small groups”) in problem</td>
</tr>
<tr>
<td>3. Circle the numbers</td>
<td>Circle numbers in word problem</td>
</tr>
<tr>
<td>4. Label graphic organizer</td>
<td>Write numbers and labels of groups on graphic organizer; put an “x” next to the unknown quantity</td>
</tr>
<tr>
<td>5. Sign and say the rule</td>
<td>State rule/use handmotions for problem type: “small group plus small group equals big group” for missing whole or “big group minus small group equals small group” for missing part</td>
</tr>
<tr>
<td>6. Fill in equation</td>
<td>Write numbers from graphic organizer in equation; two small groups for missing whole, big group on top and small group on bottom for missing part</td>
</tr>
<tr>
<td>7. + or −</td>
<td>Write addition (missing whole) or subtraction (missing part) symbol in the circle in equation</td>
</tr>
<tr>
<td>8. Solve and write answer</td>
<td>Add or subtract and (1) write numerical answer and (2) label of unknown quantity</td>
</tr>
</tbody>
</table>
reinforcement, (b) adherence to prompting hierarchy, and (c) model for error correction. The second observer collected procedural fidelity data during all sessions when IOA was collected. Procedural fidelity was calculated by dividing the number of steps correctly implemented by the total number of procedural steps and multiplying the quotient by 100 (Billingsley, White, & Munson, 1980). The mean procedural fidelity in intervention was 98% for Ricky (range 90–100), 98% (range 90–100) for Kelly, and 97% (range 80–100) for Marc.

Procedures

Baseline and probes. Participants were provided worksheets with four problems (two of each type), a pencil with an eraser, and the TA. The interventionist asked the participants to “Show me how to solve these word problems”. Word problems were read aloud if requested. Participants were given intermittent praise for completing work and staying on task (e.g., “You are working so hard”), but no specific feedback on correct or incorrect responses was provided.

Intervention. Participants were taught to solve the problems using MSBI. Key components of MSBI include: (a) creating access to the problem through read-alouds and accessible word problems, (b) promoting conceptual understanding of problem by providing graphic organizers, and (c) explicitly teaching steps of a task analysis with systematic prompting as needed (Spooner, Saunders, et al., 2017). At the beginning of each phase (e.g., MW, MP, and discrimination), the interventionist modeled how to use the TA to solve the targeted problem type for two days. During modeling sessions, the interventionist instructed participants on how to use the TA to solve the targeted problem, allowing them immediate opportunity to complete each step. No data was collected during these sessions, as participants did not have an opportunity to make an incorrect response. See Table 1 for each step of the TA and expected student response.

The “lead” phase began on the third session in each phase, and a system of least prompts was used if the participant failed to make a response within five seconds. The prompting hierarchy included a verbal prompt (e.g., restating the step of the TA), specific verbal prompt (e.g., providing specific directions on how to complete the step) and a model-retest (e.g., showing participant how to complete the step and re-presenting step). If the participant made an error, such as choosing the wrong operation, the interventionist went directly to a model prompt followed by a retest where the participant repeated the correct behavior (i.e., writing the correct operation in the equation).

Once participants had reached the mastery criteria of 16/18 steps completed independently correct across two problems of targeted problem type, a series of three probes (e.g., “test” phase) were conducted to assess maintenance of problem solving without prompting or feedback, as well as the degree of generalization and discrimination of problem solving across problem types. Following the three probe sessions, the interventionist began the explicit instruction sequence (i.e., modeling) with the next intervention phase.

In initial intervention sessions, behavior specific praise was provided after each step regardless of whether it was an independent or prompted correct response. Behavior specific praise was faded to only unprompted correct and then to completion of the problem as participants demonstrated mastery of problem solving. Two problems of the targeted problem type were presented during each intervention session. During the final intervention phase when participants were taught how to discriminate between MW and MP, a total of four problems were presented in each intervention session (two of each type). Data were taken on the number of steps of the TA the participant completed independently correct.

Results

Mathematical Problem Solving

Figure 2 shows the effect of MSBI on mathematical problem solving. The graph shows the number of steps of an 8-step TA performed independently correct across two problems of each problem type, with step 8 of the TA worth two points, one for each behavior (i.e., solve and write answer) during baseline, inter-
vention, and probe sessions. Not pictured on the graph are the two training sessions at the beginning of each intervention phase, as students were not given the opportunity to make an independent response.

During baseline all participants had a stable pattern of responding. Immediately upon receiving instruction on solving missing-whole problems, all three participants showed a change in level and increasing trend, with no overlapping data with baseline performance. Data from the first probe for each participant show maintenance of treatment effects for missing-whole problems and some generalization to the missing-part problems, but they were unable to discriminate between problem

Figure 2. Graph of number of steps of task analysis completed independently correctly. Note: Open circles indicate missing part (MP) problems; closed circles indicate missing whole (MW) problems. BL = baseline, MW = missing whole, P1 = probe 1, MP = missing part, P2 = probe 2, Disc = Discrimination between missing whole and missing part, P3 = probe 3. ★ indicates beginning to provide a highlighter.
types (see Figure 3). Immediately upon receiving instruction on solving missing-part problems, all three participants showed a change in level and increasing trend, with no overlapping data with baseline or probe performance. Data from the second probe for each participant shows maintenance of treatment effects for missing-part problems, but a decrease in missing whole problems, and an inability to discriminate between problem types.

Figure 3. Discriminations of problem type during baseline and probe sessions.
Immediately upon receiving discrimination training, participants increased independence in both problem types. Data from the final probe for each participant shows maintenance of treatment effects and discrimination of problem types for all participants. An effect size measure was calculated to confirm visual analysis (Tau-U), using an online calculator (Vannest, Parker, Gonen, & Adiguzel, 2016), resulting in an overall effect size of .87. Table 2 displays the mean and range independent responses to the task analysis for each problem-type by phase across participants. Figure 3 displays a graph of discrimination of problem type by participants across phases.

Ricky had a stable baseline for both missing-whole (average 6.2 steps) and missing-part (average 0 steps) across five sessions. After two sessions of modeling, he increased independent responding and was able to reach mastery in three sessions. During the first probe, he maintained a mastery of MW by performing all 18 steps across the two problems independently correct and generalized some responding to MP, although he was not yet able to discriminate between problem types. Ricky mastered solving MP after just four intervention sessions. In his second probe, he maintained performance on MP problems, but similarly to probe 1, was not able to discriminate. Ricky was able to master discriminating between the two problems and met mastery criteria after four intervention sessions. In the third probe, he maintained problem solving and was able to discriminate between problem types.

Kelly had a stable and consistent baseline for MW (average six steps) and MP (average 0 steps) across seven sessions. She was immediately able to increase independent responses after receiving instruction on solving MW problems and reached mastery criteria in three sessions. She maintained performance on MW problems in the first probe and had minimal generalization to MP problems. After two sessions of modeling, she increased independent responding and was able to reach mastery criteria for MP. During the first probe, she maintained a mastery of MW by performing all 18 steps across the two problems independently correct and generalized some responding to MP. Kelly was unable to discriminate between problems on the second probe. She mastered MP problems after three intervention sessions and maintained responding for MP problems on the second probe. She was unable to discriminate between problem types on the second probe, although correct responses on the second probe decreased, and she was unable to discriminate between problem types. Kelly was able to reach mastery criteria for discriminating between problem types.

Ricky had a stable baseline for both missing-whole (average 6.2 steps) and missing-part (average 0 steps) across five sessions. After two sessions of modeling, he increased independent responding and was able to reach mastery criteria for MP. During the first probe, he maintained a mastery of MW by performing all 18 steps across the two problems independently correct and generalized some responding to MP. Although he was not yet able to discriminate between problem types, he maintained a mastery of MW by performing all 18 steps across the two problems independently correct and generalized some responding to MP.

Kelly had a stable and consistent baseline for MW (average six steps) and MP (average 0 steps) across seven sessions. She was immediately able to increase independent responses after receiving instruction on solving MW problems and reached mastery criteria in three sessions. She maintained performance on MW problems in the first probe and had minimal generalization to MP problems. After two sessions of modeling, she increased independent responding and was able to reach mastery criteria for MP. During the first probe, she maintained a mastery of MW by performing all 18 steps across the two problems independently correct and generalized some responding to MP. Kelly was unable to discriminate between problems on the second probe. She mastered MP problems after three intervention sessions and maintained responding for MP problems on the second probe, although correct responses on the second probe decreased, and she was unable to discriminate between problem types. Kelly was able to reach mastery criteria for discriminating between problem types.

Mark had a stable baseline for MW (average 2 steps) and MP (average 0 steps) across five sessions. After two sessions of modeling, he increased independent responding and was able to reach mastery criteria for MP. During the first probe, he maintained a mastery of MW by performing all 18 steps across the two problems independently correct and generalized some responding to MP. Mark was unable to discriminate between problems on the second probe. He mastered MP problems after three intervention sessions and maintained responding for MP problems on the second probe, although correct responses on the second probe decreased, and he was unable to discriminate between problem types. Mark was able to reach mastery criteria for discriminating between problem types.

Table 2 displays the mean and range of independent responses to the task analysis for each problem-type by phase across participants. Table 2 shows the following data:

<table>
<thead>
<tr>
<th></th>
<th>MW IV</th>
<th>P1</th>
<th>MP IV</th>
<th>P2</th>
<th>DISC IV</th>
<th>P3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MW</strong></td>
<td>6.2</td>
<td>15.7 (13–18)</td>
<td>18</td>
<td>4.6 (4–6)</td>
<td>16 (15–18)</td>
<td>9.6 (9–10)</td>
</tr>
<tr>
<td><strong>MP</strong></td>
<td>0</td>
<td>15.7 (13–18)</td>
<td>18</td>
<td>4.6 (4–6)</td>
<td>16 (15–18)</td>
<td>9.6 (9–10)</td>
</tr>
<tr>
<td><strong>MW</strong></td>
<td>6</td>
<td>16 (15–18)</td>
<td>15.6 (14–16)</td>
<td>4</td>
<td>16.3 (16–17)</td>
<td>8.3 (8–9)</td>
</tr>
<tr>
<td><strong>MP</strong></td>
<td>0</td>
<td>16 (15–18)</td>
<td>15.6 (14–16)</td>
<td>4</td>
<td>16.3 (16–17)</td>
<td>8.3 (8–9)</td>
</tr>
<tr>
<td><strong>MW</strong></td>
<td>2</td>
<td>115.5 (4–17)</td>
<td>14 (12–16)</td>
<td>4.6 (4–6)</td>
<td>13.9 (11–16)</td>
<td>13.6 (11–16)</td>
</tr>
<tr>
<td><strong>MP</strong></td>
<td>0</td>
<td>115.5 (4–17)</td>
<td>14 (12–16)</td>
<td>4.6 (4–6)</td>
<td>13.9 (11–16)</td>
<td>13.6 (11–16)</td>
</tr>
</tbody>
</table>

**Note:** MW IV = missing-whole problem-type intervention, P1 = probe 1, MP IV = missing-part problem-type intervention, P2 = probe 2, DISC IV = discrimination between problem-type intervention, P3 = probe 3, MW = missing whole problems, MP = missing part problems.
ing between problem types after three intervention sessions and maintained responding during the third probe.

Marc had a stable and consistent baseline for MW (average two steps) and MP (average 0 steps) problems across eight sessions. Following two sessions of modeling for MW problems he demonstrated an immediate jump and increasing trend in independent responding to the task analysis although this was a slower progression than other participants, taking 10 sessions to reach mastery criteria. In the first probe Marc maintained problem solving for the MW problem type, although there was some variability to his responding it did not overlap with baseline. He was not able to discriminate between problems. Marc’s performance during MP intervention plateaued after nine sessions. He consistently had difficulty with independently discriminating the problem as MP and saying the corresponding rule and operation. In the 10th missing-part intervention sessions, researchers provided Marc with a highlighter and showed him how to highlight the “x” on the graphic organizer, which then assisted him in determining the rule, operation, and label. This additional visual support resulted in an immediate increase in independent responding on these steps and therefore allowed him to reach mastery criteria following the eleventh session. Interventionists made the highlighter available to Marc in all subsequent sessions. In the second probe Marc was able to maintain responding to both missing-whole and missing-part problems, although neither were at mastery level and he did not discriminate between the two. Marc mastered discriminating between problem types after four intervention sessions. His performance on the final probe was variable for both problem type, although it was well above baseline, and he was able to discriminate between problem types on three out of four problems for two sessions.

Discussion

The purpose of this study was to evaluate the effects of MSBI on mathematical problem solving by students with ASD. Participants were taught to solve group problems that required algebraic reasoning using MSBI, which included explicit instruction, an 8-step task analysis, a graphic organizer, and visual support for writing an equation. A functional relation was found between MSBI and problem solving. Non-parametric effect size (Tau-U) confirmed visual analysis of a large effect (.87). All participants were able to discriminate between problem types to choose the correct operation and solve problems.

Mathematical problem solving is a pivotal skill, yet it has not received as much attention from researchers as basic and discrete applications of mathematics (King, Lemons, & Davidson, 2016; Spooner et al., 2018). Although algebra is a distinct domain of mathematics, algebraic reasoning is required for fluency and conceptual knowledge across domains (Van de Walle et al., 2016). Students with ASD/ID face several barriers to becoming fluent “algebra problem solvers”, including working memory, executive functioning, and language, and require explicit learning strategy instruction to access this general curriculum content.

The results of this study make an important contribution to the field’s knowledge on the application of evidence-based practices to teach mathematical problem solving to students with ASD/ID. MSBI incorporates several established evidence-based practices, including systematic instruction, graphic organizer training, and explicit instruction (Spoon er, Root, et al., 2018). These findings extend the boundaries on generalization of problem solving established by prior MSBI studies, including successful application of the strategy to more complex domains of mathematics (i.e., algebra) and calculation of double digit numbers. In addition, the results of this study highlight the need for explicit discrimination training.

Solving mathematical word problems requires simultaneous employment of multiple complex skills to select and execute an appropriate strategy based on correct interpretation of the problem (Jitendra et al., 2015), including working memory and executive functioning (Rockwell et al., 2011). Participants in the current study were tasked with solving two similar yet distinctly different problems; the discrimination was based on whether the problem was asking for the size of the total or the size of one of the parts. The task analysis made this difference salient as the participants
mapped the known information on the graphic organizer, indicated what was unknown with an x, and said the corresponding rule. However, all participants in the study required explicit discrimination training in order to independently discriminate between MW and MP problems. Prior to explicit discrimination training, they overgeneralized problem solving and approached each problem as the most recently taught type. For example, in probe two all participants solved each problem as a MP, as that was what was most recently taught, even though they had demonstrated mastery on MW problems in probe one. The findings from this research fill an important gap in the research highlighted by the findings of Root and Browder (2017), where participants had difficulty discriminating between MW and MP problem types when presented concurrently and not provided with explicit discrimination training.

Implications for Practice

The ability to solve word problems is an important skill for all students, as it lays a foundation for reasoning and problem solving that translates to real-world scenarios and more advanced levels of mathematics (Powell & Fuchs, 2014; Van de Walle et al., 2016). For students with ASD/ID who are having difficulty in solving word problems, MSBI can support them in conceptually understanding what is happening in the problem and support their procedural knowledge of how to arrive at a solution. While traditional schema-based instruction is an evidence-based practice for students with high incidence disabilities, practitioners can consider their students’ abilities and determine if they would benefit from the additional support provided through MSBI. For example, in MSBI, a task analysis is used instead of a mnemonic (e.g., RUNS or FOPS) as a heuristic for solving the problem. Students who have limited early literacy skills and cannot equate the R in the “RUNS” mnemonic with the R in “Reading”, or those who need complex steps such as “name the problem type” further broken down into component steps, may benefit from the task analysis that pairs considerate text with pictures. In addition, use of a task analysis in mathematics promotes self-management, an evidence-based practice for students with ASD (Barnett & Cleary, 2016; Wong et al., 2014).

Finally, practitioners can incorporate explicit discrimination training into instructional routines; otherwise students may overgeneralize problem solving strategies. When teaching two-choice tasks (i.e., MW and MP), Engelmann and Carnine (1982) suggest teaching the first concept to mastery (i.e., MW), then the second concept to mastery (i.e., MP), before teaching students to discriminate between the two concepts.

Limitations and Future Research

There are several limitations to this study that suggest the need for future research. First, this study only addressed one type of additive problems (i.e., group). Second, the problems in this study followed a highly structured and predictable format, and did not contain any extraneous information. Third, although the word problems did address quantities larger than 10, regrouping was not required. Future research could evaluate the feasibility and effectiveness of MSBI to solve and discriminate between problems of multiple problem types that include extraneous information and require additional computational skills, as is generally found in general education mathematics texts. In addition, while this study has construct validity and addresses a socially important skill, the lack of direct social validity measure from the teacher or participants is a limitation. Finally, it is unknown whether the participants in this study were able to generalize their knowledge to real-world mathematical problem solving scenarios that involve algebraic reasoning. Future research should directly measure, and if necessary teach, generalization of problem solving skills to authentic real-world contexts, such as in daily living, leisure, or vocational settings.

References


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The eighth volume of the CEC Division on Autism and Developmental Disabilities’ Prism series, *Friendship 101* focuses on building social competence, friendship making, and recreation and leisure skills among students with autism spectrum disorder and other developmental disabilities. Chapters in this evidence-based, user-friendly guide address the needs of students in different developmental periods (from pre-K through young adulthood), providing teachers, parents, faculty and teacher educators with tools and strategies for enhancing the social skill development of these children and youth. Presented through an ecological perspective, together these chapters emphasize building social competence within and across school, home, and community contexts.

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